VCBO

BID SET
VOL. 01: DIVISIONS 00 THRU 33

LIFE TIME - HERRIMAN

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PROJECT NO.	VCBO 25085.00
DATE	17 DECEMBER 2025

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END OF SECTION

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SECTION 00 31 00
AVAILABLE PROJECT INFORMATION

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A. Information that is made available to Bidders is for reference only, and is not intended to be part of the Contract.
   1. **Geotechnical Evaluation Report (Available on Pro Core)**
   2. **Existing Building Drawings (Available on Pro Core)**

1.02 USE OF INFORMATION PROVIDED

A. Bidders are encouraged to review information available to Bidders prior to submitting a Bid, and obtain additional information if Bidder desires.

B. Owner will not consider requests for additional compensation for extra Work due to conditions that reasonably could have been anticipated from the information provided.

1.03 INTERPRETATION

A. Owner supplied information is provided only for information and convenience to Bidders. Owner and Architect disclaim responsibility for accuracy of information that has been prepared by others. Owner and Architect further disclaim responsibility for interpretation of that information by Bidders.

1.04 GEOTECHNICAL DATA

A. ***Owner has engaged services of testing agency indicated below to report on subsurface conditions to provide design information.***

B. ***Borings: Soil data and logs may be available for inspection at office of Owner and Contractor***

C. ***Data Use Limitations: Because sub-surface conditions indicated by borings are sampling in relation to entire construction area, and for other reasons, Owner, Architect, or firm reporting sub-surface conditions based on borings, do not warrant conditions below depths of borings or that strata logged from borings are necessarily typical of entire site.***

D. ***Parties using soil information described in this Document accept full responsibility for its use and obtaining additional soil information that may be required.***

E. ***Extra Payment Limitations: No consideration for extra payment will be given for conditions occurring that could have been anticipated from soil information. If conditions occur resulting in extra Work that could not have been anticipated or reasonably inferred from the soil information, Conditions of the Contract for changes in Work will apply.***

1.05 EXISTING BUILDING DRAWINGS

A. ***Owner has made drawings of the existing building available on the project website (Pro Core).***

B. ***Owner does not warrant conditions of existing building as it currently exists. Drawings are provided for reference only and does not relieve Contractors of obligation to provide field verification.***

C. ***Parties using existing drawings described in this Document accept full responsibility for its use and obtaining additional information that may be required.***

D. ***Extra Payment Limitations: No consideration for extra payment will be given for conditions occurring that could have been anticipated from information provided. If conditions occur resulting in extra Work that could not have been anticipated or reasonably inferred from the information, Conditions of the Contract for changes in Work will apply.***

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

ATTACHMENTS

GEOTECHNICAL REPORT

EXISTING BUILDING DRAWINGS

END OF SECTION

Western Technologies
An RMA Company

GEOTECHNICAL EVALUATION REPORT

LIFE TIME ATHLETIC COUNTRY CLUB - HERRIMAN

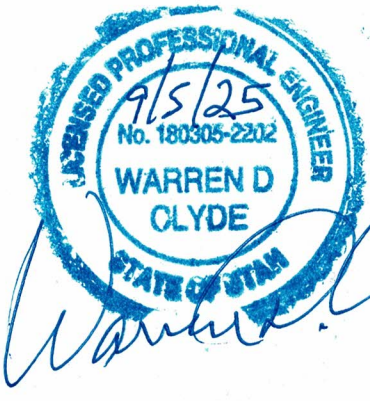
NEC Mountain View Corridor and 12600 South
Herriman, Utah
WT Reference No. 61-224216-0

PREPARED FOR:

Life Time Property Development
2900 Corporate Place
Chanhassen, MN 55317

Attn: Mr. Justin Schmidt

September 5, 2025



Warren D. Clyde, P.E.
Principal

Kim Riding, P.E.
Salt Lake Area Manager

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GEOTECHNICAL EVALUATION
LIFE TIME ATHLETIC COUNTRY CLUB – HERRIMAN, UTAH
NEC MOUNTAIN VIEW CORRIDOR AND 12600 SOUTH
HERRIMAN, UTAH
REFERENCE NO. 61-224216-0

1.0 EXECUTIVE SUMMARY

Soils on the site consist mainly of silt and clay with layers of silty or clayey gravel. Some of these soils exhibit collapse potential with an increase in moisture content. The soils also vary across the site.

The clay and silt soils are difficult to compact in cold and wet weather.

Foundations, slabs, pool decks, and pool shells should be placed upon non-collapsible native soils or on engineered fill extending to non-collapsible soils as recommended in the report.

The Seismic Site classification for IBC 2021 is “C” based upon the average shear wave velocity profile. Settlement and lateral spread for the site is not anticipated.

Fifteen additional borings were done to determine the depth of collapsible soils below the existing ground surface. Samples were taken and collapse tests were performed at different depths to determine the extent of the collapsible soils below the surface. The depth of the collapsible soils ranged from 2 feet to 8 feet below the existing ground surface.

2.0 PURPOSE

This report contains the results of our geotechnical evaluation for a proposed Life Time Facility – Herriman to be located in Herriman, Utah. The purpose of these services is to provide information and recommendations regarding:

- Subsurface conditions
- Foundation design parameters
- Lateral earth pressures
- Earthwork guidelines
- Pavement sections
- Groundwater
- Corrosivity (soil to concrete)
- Slabs-on-grade
- Seismic conditions
- Excavation conditions

- Drainage
- Infiltration rates
- Geologic hazards
- Geology

Results of the field exploration, field tests, and laboratory testing program are presented in the Appendices.

3.0 PROJECT DESCRIPTION

Project information supplied by Mr. Justin Schmidt on January 8, 2025 indicates the proposed Life Time Facility will be a EBox + prototype using steel superstructure construction. The maximum wall and column loads as given in the RFP are as follows:

- Wall loads 20 kips per lineal foot (klf)
- Interior Columns 600 kips
- Perimeter Columns 450 kips
- Floor slab-on-grade 150 pounds per square foot
- Lightly loaded structures (i.e. bistro, water slides, etc.) 25 kips per column and 3 klf

The allowable settlements are as follows:

- Total settlement of foundations: less than 2 inches
- Differential settlement for building and pavement areas less than 1 inch in 100 feet and ½ inch in 30 feet
- Differential settlement for pool vessel, slabs and pool deck ½ inch in 100 feet and ¼ inch in 30 feet
- Differential settlement between pool deck and pool: less than ½ inch

Asphalt concrete paved parking areas and drives will be included as part of the proposed development. Final site grading plans were not available at the time of this report. Should this information not be correct we should be notified immediately.

4.0 SCOPE OF SERVICES

4.1 Field Exploration

Eleven borings were drilled to depths of about 26.5 feet below existing site grade in the proposed building and pool areas. Thirteen borings were drilled to depths of about 11.5

feet in the proposed paved parking, drive and sport court areas. The borings were at the approximate locations shown on the attached Boring Location Diagram. A field log was prepared for each boring. These logs contain visual classifications of the materials encountered during drilling as well as interpolation of the subsurface conditions between samples. Final logs, included in Appendix A, represent our interpretation of the field logs and may include modifications based on laboratory observations and tests of the field samples. The final logs describe the materials encountered, their thickness, and the locations where samples were obtained.

Fifteen additional borings were drilled to depths of about 11.5 feet below existing site grade in the proposed building and pool areas. The borings were at the approximate locations shown on the attached Boring Location Diagram. A field log was prepared for each boring. These logs contain visual classifications of the materials encountered during drilling as well as interpolation of the subsurface conditions between samples. Final logs, included in Appendix A, represent our interpretation of the field logs. The final logs describe the materials encountered, their thickness, and the locations where samples were obtained.

The Unified Soil Classification System was used to classify soils. The soil classification symbols appear on the boring logs and are briefly described in Appendix A. Local and regional geologic characteristics were used to estimate the seismic design criteria, and the shear wave velocity to 100 feet deep as measured.

4.2 Laboratory Analyses

Laboratory analyses were performed on representative soil samples to aid in material classification and to estimate pertinent engineering properties of the on-site soils for preparation of this report. Testing was performed in general accordance with applicable standard test methods. The following tests were performed and the results are presented in Appendix B.

- Water content
- Dry density
- Plasticity
- Minus #200 and #4 sieves
- Consolidation/collapse
- Soluble sulfate content

4.3 Analyses and Report

This geotechnical engineering report includes a description of the project, a discussion of the field and laboratory testing programs, a discussion of the subsurface conditions, and

design recommendations as appropriate to its purpose. The scope of services for this project does not include, either specifically or by implication, any environmental assessment of the site, discovery of underground storage tanks or other underground structures, or identification of contaminated or hazardous materials or conditions. If there is concern about the potential for such contamination, other studies should be undertaken. We are available to discuss the scope of such studies with you.

5.0 SITE CONDITIONS

5.1 Surface

At the time of our exploration, the site was essentially undeveloped. The ground surface was relatively flat sloping down towards the southeast and contained a moderate growth of brush and grasses. Site drainage trended to the southeast as sheet surface flow. Other site features included a large fill pile in the northeast portion of the site.

5.2 Subsurface

As presented on the Boring Logs in the building and pool areas, surface soils to the full depth of exploration consisted of layers of very soft to very stiff silt and clay plus layers of loose to very dense clayey sand, sandy gravel and silty sand. Near surface soils are of low to high plasticity.

Soils in the pavement and sport court areas consisted mainly of silt and clay with some silty sand and clayey sand to the full depth explored.

Collapsible soils were present in the surface soils to a depth of 7 to 8 feet. Additional borings have been done and collapse testing is in process to define the depth of the collapsible soils in the building and pool areas. An addendum will be issued when the collapse testing is completed.

5.3 Groundwater

Groundwater was not encountered in any test boring at the time of exploration. These observations represent the groundwater conditions at the time of exploration and may not be indicative of other times. Groundwater levels can be expected to fluctuate with varying seasonal conditions.

5.4 Geology and Geologic Hazards

The Site is located in the Jordan Valley west of the western slope of the Central Wasatch Range section of the Middle Rocky Mountains Province. The Wasatch Range trends north-south and includes broad alluvial valley bottoms and low hills in the north and rugged mountains cut by deep valleys in the south. The Site is in an area bounded by the Great Salt Lake to the north, the Oquirrh Mountains to the west, the Traverse Mountains to the south, and the Wasatch Mountains to the east. The Site is located on lacustrine sand and silt consisting of fine- to coarse-grained sand and silt with minor gravel (*Geologic Map of the Copperton Quadrangle, Salt Lake County, Utah*, Utah Geological Survey, 2007).

5.5 Geologic Hazards

The nearest mapped fault is approximately 8 miles to the east. According to the Salt Lake County *Surface Fault Rupture Liquefaction Potential Special Study Areas Map,* the Site is located in a "very low" liquefaction potential area and surface fault rupture is not expected.

6.0 GEOTECHNICAL PROPERTIES & ANALYSIS

6.1 Laboratory Tests

Laboratory test results (see Appendix B) indicate that on-site subsoils near shallow foundation level exhibit low to medium compressibility or slight expansion at existing water contents. Low to medium additional compression occurs when the water content is increased.

Near-surface soils are of low to high plasticity. These soils typically exhibit low expansion potential when recompacted, confined by loads approximating floor loads and saturated. Slabs-on-grade supported on recompacted on-site soils have a low potential for heaving if the water content of the soil increases.

Chemical tests were performed on representative samples of the surficial on-site soils to determine the amount of water-soluble sulfate and chloride. The tests were performed by Chemtech-Ford Laboratories, and the test results are presented in Appendix B.

6.2 Field Tests

On-site subsoils near shallow foundation level exhibited medium resistance to penetration using the standard penetration test method (ASTM D1586) and ring-lined barrel sampler (ASTM D3550). Penetration resistance values exhibited some variability between test locations. This represents a potential for differential movement within structures supported on existing soils in their present condition.

The boring logs included in this report are indicators of subsurface conditions only at the specific location and date noted. Variations from the field conditions represented by the borings may become evident during construction. If variations appear, we should be contacted to re-evaluate our recommendations.

7.0 RECOMMENDATIONS

7.1 General

Recommendations contained in this report are based on our understanding of the project criteria described in Section 2.0 and the assumption that the soil and subsurface conditions are those disclosed by the explorations. Others may change the plans, final elevations, number and type of structures, foundation loads, and floor levels during design or construction. Substantially different subsurface conditions from those described herein may be encountered or become known. Any changes in the project criteria or subsurface conditions shall be brought to our attention in writing.

7.2 Design Considerations

Some of the surficial on-site soils encountered are very soft in consistency. In addition, laboratory test results indicate that these soils become weaker and collapsible with an increase in moisture content. These soils are not suitable for support of foundations in their present state and should be over-excavated and recompacted as recommended in the **EARTHWORK** section of this report. Proper drainage should be provided to help prevent infiltration of moisture below the foundations.

7.3 Depth of Collapsible Soils

Based upon the additional borings, the following table summarizes the depth of collapsable soils below the existing ground surface at the time of exploration:

Additional Boring Number	Depth of Collapsible Soil (feet)
AB-1	6
AB-2	6
AB-3	8
AB-4	8
AB-5	6
AB-6	6
AB-7	6
AB-8	8
AB-9	8
AB-10	2
AB-11	6
AB-12	6
AB-13	6
AB-14	6
AB-15	3

7.4 Foundations

Because of variations in bearing soils, foundation bearing levels, structural loads and settlement criteria given, we considered the following foundation systems. These alternative foundation systems present various economic, design, and performance comparisons for your consideration.

- Shallow footings on engineered fills
- Shallow footings on recompacted native soils

7.4.1 Spread Foundations on Recompacted Native Soils

Shallow spread-type footings may be used to support the proposed structures. Since the on-site soils exhibit variable settlement potentials, the foundations should bear on engineered fills achieved by removal and recompaction soils below foundations, slabs,

pool decks, and pool shells. The depth and lateral extent of the engineered fills is presented in the **EARTHWORK** section of this report. The existing fill, collapsible soils, and topsoil on the site should not be used for support of foundations.

Alternative footing depths and allowable bearing capacities on recompacted native soils fill as recommended in the earthwork section are presented in the following tabulation:

Footing Depth Below Finished Grade[1] (ft)	Net Allowable Bearing Capacity[2] (psf)
2.5[3] exterior	1500
1.5 interior	1500

The allowable bearing capacity is based upon the thickness of engineered fill as presented in the earthwork section of this report. An increase in bearing capacity for interior footings placed deeper than the minimum depth above is not allowed.

Minimum frost depth is 30 inches for exterior footings or footings in unheated spaces. This depth may be mitigated by using frost protection methods for footings as allowed by the building code.

We anticipate that total settlement of the proposed structures, supported as recommended, should be as follows:

- Total settlement of foundations: less than 2 inches
- Differential settlement for building and pavement areas: less than 1 inch in 100 feet and ½ inch in 30 feet
- Pool Vessel, Slabs, and Pool Deck: ½ inch in 100 feet and ¼ inch in 30 feet
- Differential settlement between Pool Deck and Pool: less than ½ Inch

[1] Finished grade is the lowest adjacent grade for perimeter footings and floor level for interior footings.

[2] Allowable bearing capacities assume fulfillment of **EARTHWORK** recommendations. Pounds per square foot (psf). The net bearing capacity means the weight of the concrete for footings and foundation is not included in the design of structural load on the soil. A 1/3 increases for short term loads may be used only if the alternative load combinations given in section 1605.3.2 of the IBC are used.

[3] Minimum depth for frost protection of exterior footings or footings in unheated spaces.

7.4.2 Spread Foundations on Engineered Fills

If higher bearing capacities are required, shallow spread-type footings on imported engineered fill may be used to support the proposed structures. The engineered fill should extend to the non-collapsible native soils The depth and lateral extent of the engineered fills is presented in the **EARTHWORK** section of this report.

Alternative footing depths and allowable bearing capacities on imported engineered fill as recommended in the earthwork section are presented in the following tabulation:

Footing Depth Below Finished Grade[4] (ft)	Net Allowable Bearing Capacity[5] (psf)
2.5[6] exterior	3000
1.5 interior	3000

The allowable bearing capacity is based upon the thickness of engineered fill as presented in the earthwork section of this report. An increase in bearing capacity for interior footings placed deeper than the minimum depth above is not allowed.

Minimum frost depth is 30 inches for exterior footings or footings in unheated spaces. This depth may be mitigated by using frost protection methods for footings as allowed by the building code.

We anticipate that total settlement of the proposed structures, supported as recommended, should be as follows:

- Total settlement of foundations: less than 2 inches

[4] Finished grade is the lowest adjacent grade for perimeter footings and floor level for interior footings.

[5] Allowable bearing capacities assume fulfillment of **EARTHWORK** recommendations. Pounds per square foot (psf). The net bearing capacity means the weight of the concrete for footings and foundation is not included in the design of structural load on the soil. A 1/3 increase for short term loads may be used only if the alternative load combinations given in section 1605.3.2 of the IBC are used. WT should be allowed to review the increased loads if used.

[6] Minimum depth for frost protection of exterior footings or footings in unheated spaces.

- Differential settlement for building and pavement areas: less than 1 inch in 100 feet and ½ inch in 30 feet
- Pool Vessel, Slabs, and Pool Deck: ½ inch in 100 feet and ¼ inch in 30 feet
- Differential settlement between Pool Deck and Pool: less than ½ Inch

7.5 Lateral Design Criteria

Lateral loads may be resisted by concrete interface friction and by passive resistance. For shallow foundations bearing on properly recompacted soils or imported engineered fill at this site, we recommend the following lateral resistance criteria:

- Recompacted Native Soils Passive:
  Shallow wall footings.....250 psf/ft
  Shallow column footings.....375 psf/ft

- Coefficient of allowable base friction (passive).....0.30

Earth retaining structures less than 10 feet in height, above any free water surface, with level backfill and no surcharge loads may be designed using the equivalent fluid pressure method. Recommended active equivalent fluid pressures and coefficients of base friction for unrestrained elements are:

- Active:
  Undisturbed subsoil.....45 psf/ft
  Compacted granular backfill.....35 psf/ft
  Clay site soils.....not recommended for use

- Coefficient of base friction (active).....0.40

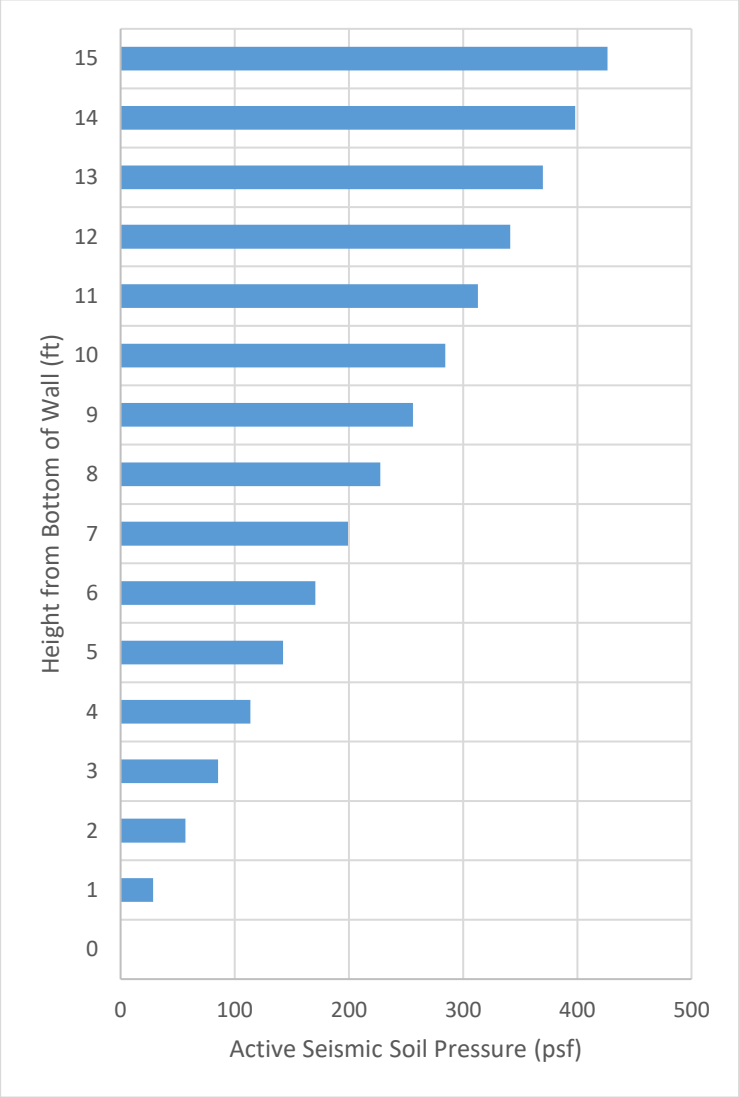
The active base friction should be reduced to 0.30 when used in conjunction with passive pressures.

Where the design includes restrained elements, the following equivalent fluid pressures are recommended:

- At-rest:
  Undisturbed subsoil.....65 psf/ft
  Compacted granular backfill.....55 psf/ft

- Seismic:

  The following pressure distribution for undisturbed subsoil and compacted granular backfill may be used for seismic lateral loads for both active and at rest retaining walls:



The equivalent fluid pressures presented herein do not include the lateral pressures arising from the presence of:

- hydrostatic conditions, submergence or partial submergence
- sloping backfill, positively or negatively
- surcharge loading, permanent or temporary

We recommend a free-draining soil layer or manufactured geosynthetic (drain tile) material be constructed adjacent to the back of any retaining walls. A filter may be required between the soil backfill and drainage layer. This drainage zone should help prevent development of hydrostatic pressure on the wall. This vertical drainage zone should be tied into a gravity drainage system at the base of the wall. It is important that all backfill be properly placed and compacted. Backfill should be mechanically compacted in layers. Flooding or jetting should not be permitted. Care should be taken not to damage the walls when placing the backfill. Backfills should be observed and tested during placement.

Fill against footings, stem walls, and any retaining walls should be compacted to densities specified in **EARTHWORK**. Clayey soils should not be used as backfill against retaining walls. Compaction of each lift adjacent to walls should be accomplished with hand-operated tampers or other lightweight compactors. Over-compaction may cause excessive lateral earth pressures that could result in wall movements.

7.6 Post Tensioned Sport Courts

Post tensioned sport court slabs should be placed on engineered fill extending to non-collapsible soils. The engineered fill should extend beyond the post tensioned slabs a minimum of 5 feet. A minimum of 6 inches of untreated base should be placed below the post tensioned slabs.

7.7 Landscape Berm and Screen Wall

A landscape berm and screen wall is proposed along the north edge of the site. Soil placed for the berm should be compacted to the requirements for engineered fill. Footings for the screen wall may be placed in the compacted engineered fill of the berm.

7.8 Pools

It is our understanding that the pools require a 1/16-inch differential settlement tolerance for the larger pools and a 1/8-inch differential settlement tolerance for the smaller pools. This tolerance is different than the tolerances stated in the request for proposal. Pool shells should be supported on imported untreated base. The untreated base should extend to native undisturbed soils and have a minimum thickness of 2 feet below the shell. The untreated base should extend a minimum of 2 feet beyond the pool shell. In addition, the pool should be surcharged (filled) prior to placement of the pool gutter edge/overflow lip. The lip should be surveyed prior to surcharge and again after surcharge to see if significant settlement occurs. If significant settlement is measured then the

surcharged pool should be allowed to settle and be resurveyed until no significant settlement is observed. Clean gravel may be used as engineered fill below pools and in drain areas below the shell provided a geotextile filter fabric is placed between the gravel and soils containing fines. The pool shell should be relatively consistent in thickness. Large blocks of concrete for areas such as stairs or shallow shelves should not be placed but the shell thickness should be limited using Geofoam, clean gravel in sand bags, etc. in these areas. Voids caused by side wall collapse requiring back forming should be filled with clean gravel.

7.9 Seismic Considerations

A refraction micro-tremor (ReMi) seismic test was performed to estimate the shear wave velocity profile at the site for assessment of the seismic site classification in accordance with the 2021 IBC. The test was performed at the approximate location shown on the attached Boring Location Diagram.

Based upon the interpreted shear wave velocity profile (see Plate C-1), the average velocity, using the IBC calculation method, between the approximate depths of 0 and 100 feet was estimated to be 2221.8 feet per second. Based upon the calculated average shear wave velocity and the 2021 IBC, the site may be assigned a "C" soil classification. The Shear Wave Velocity Profile generated from the seismic data obtained at the site is provided in Appendix C.

Structures should be designed in accordance with applicable building codes. The seismic design parameters presented in the following table, in accordance with the 2021 International Building Code and ASCE 7-16, are applicable to the project site:

Seismic Design Parameters International Building Code 2021, ASCE 7-16	
Soil Site Class	C
Mapped Spectral Response Acceleration at 0.2 sec period (S_s)	1.08g
Mapped Spectral Response Acceleration at 1.0 sec period (S_1)	0.388g
Site Coefficient for 0.2 sec period (F_a)	1.2
Site Coefficient for 1.0 sec period (F_v)	1.5
Design Spectral Response Acceleration at 0.2 sec period (S_{DS})	0.864g
Design Spectral Response Acceleration at 1.0 sec period (S_{D1})	0.388g

7.10 Conventional Slab-on-Grade Support

Floor and deck slabs can be supported on properly placed and compacted fill. The slab subgrade should be prepared by the procedures outlined in this report. A minimum 4-inch layer of clean ¾ inch aggregate or base course should be provided beneath all slabs to help prevent capillary rise and a damp slab.

For design of slabs-on-grade, we recommend using a modulus of subgrade reaction (k) of 225 pounds per cubic inch (pci) for a minimum of 12 inches of the imported fill material.

Life Time Property Development standard design requires a 15 mil vapor barrier below slabs-on-grade where the floor will be covered by products using water based adhesives, wood, vinyl backed carpet, impermeable floor coatings (urethane, epoxy, acrylic terrazzo, etc.) or where the floor will be in contact with moisture sensitive equipment or product. The design and installation should be in accordance with the recommendations given in ACI 302.1R and 302.2R and Life Time standards.

All concrete placement and curing operations should follow the American Concrete Institute manual recommendations. Improper curing techniques and/or high slump (high water-cement ratio) could cause excessive shrinkage, cracking or curling. Concrete slabs should be allowed to cure adequately before placing vinyl or other moisture sensitive floor covering.

7.11 Drainage

A major cause of soil problems in this vicinity is moisture increase in the soils below structures. It is important that positive drainage be provided during construction and maintained throughout the life of the structures. Infiltration of water into utility or foundation excavations must be prevented during construction. In areas where sidewalks or paving do not immediately adjoin the structures, protective slopes should be provided with an outfall of 5 percent for at least 10 feet from perimeter walls. Scuppers and drainpipes should be designed to provide drainage away from the structures for a minimum of 10 feet. Backfill against footings, exterior walls, and in utility and sprinkler line trenches should be well compacted and free of all construction debris to minimize the possibility of moisture infiltration.

Water and sewer utility lines should be properly installed to avoid possible sources for subsurface saturation. It is important that all utility trenches be properly backfilled. If

practicable, planters and/or landscaping should not be constructed adjacent to or near structures. If planters and/or landscaping are adjacent to or near the structures, we recommend the following:

- Grades should slope away from the structures
- Only shallow rooted landscaping should be used
- Watering should be kept to a minimum

Soils below sidewalks, paver areas and sport courts should be prepared according to the **Section 8.7 Exterior Slab Preparation**. The soils directly below the sidewalks, pavers and sport courts should consist of a minimum of 4 inches of untreated base.

7.12 Drain Tile

All pools and below-grade structures should be provided with a perimeter drain tile. Swimming pool drain tiles should follow Life Time standard design requirements, namely a perimeter drain tile with a segment also running beneath the main drain sumps as well as possibly running beneath the pool floor slabs. Additional drain tile may be required in elevators, shower cores, pools/spas, outdoor turf areas as well as pump pits and surge tanks.

7.13 Corrosivity to Concrete

The chemical test results indicate that the soils at the site classify as Class S0 in accordance with Table 19.3.1.1 of ACI 318-19. Concrete should be made that has a maximum water-cementitious materials ratio and minimum compressive strength set forth in Table 19.3.2.1 of ACI 318-19 according to the requirements for this classification.

7.14 Storm Water Infiltration

Infiltration testing has been performed within the proposed retention/detention basin. Three 8-inch diameter borings were drilled to depths of 3 to 4 feet below the existing site grade. A 2–inch inside-diameter slotted PVC pipe was placed into the boring and clean ¾-inch gravel was placed around the pipe. The borings were filled with water and allowed to saturate over night. Falling-head infiltration tests were performed within the 8 inch boring. The test results are as follows:

Infiltration Test No.	Depth below Existing Grade to Top of Surface Being Tested, (feet)	Approximate Stabilized Rate of Infiltration, (minutes/inch)
PT-1	3.25	14
PT-2	3.5	5
PT-3	2.5	83

The test results are only applicable at the depth and location indicated in the report. The varying areas of soil could affect the infiltration rates and possibly stop infiltration. We recommend the geotechnical engineer or his qualified representative review the basin excavations when they have been excavated to grade. Additional infiltration testing may be required.

7.15 Pavements

Based on the traffic loads provided in the RFP design parameters, traffic loads will be as follows:

- Light-Duty Pavement Areas – 5 equivalent 18-kip axle loads (ESALs) per day
- Heavy-Duty Pavement Areas – 15 ESALs per day

Therefore, based on the existing subgrade conditions, a design CBR-value of 3, a reliability value of 90 percent, and a resilient modulus of 4500 psi and a Terminal Serviceability Index of 2.5, the following pavement sections are recommended for a 20-year design life:

Traffic Area	Asphalt Concrete Pavement (inches)	Base Course (inches)	Subbase Course (inches)	PCC (inches)	Base Course (inches)
Light-Duty Pavements	3	8	--	5	4
Heavy-Duty Pavements	3	12	--	6	6
	3	6	9	6	6

The minimum portland cement pavement section is based on a minimum compressive strength of 4,500 pounds per square inch and being placed on a properly prepared subgrade and base course.

PCC non-reinforced pavements should contain properly spaced weakened plane control joints in both the longitudinal and transverse directions. Normal control joints should be square patterns not to exceed 10 feet per side. All control joints should have a depth of at least 1/3 of the slab thickness. Depending on the method used, control joints should be cut as soon as possible during curing operations to prevent random cracking. Structures and features projecting into the pavement should be isolated from the pavement with a 1-inch thick pre-molded expansion joint material. Transverse expansion joints should be placed at proper intervals to provide expansion/contraction relief. All joints should be cleaned and sealed with an approved material prior to opening to traffic.

The American Concrete Institute's, Guide for the Design and Construction of Concrete Parking (ACI 330R), should be used for reference. Field and laboratory testing of the concrete and base materials should be performed to determine whether specific requirements have been meet.

8.0 EARTHWORK

8.1 General

The conclusions contained in this report for the proposed construction are contingent upon compliance with recommendations presented in this section. Any excavating, trenching, or disturbance that occurs after completion of the earthwork must be backfilled, compacted and tested in accordance with the recommendations contained herein. It is not reasonable to rely upon our conclusions and recommendations if any future unobserved and untested trenching, earthwork activities or backfilling occurs.

Although underground facilities such as septic tanks, cesspools, basements, utilities, and dry wells were not observed, such features might be encountered during construction. These features should be demolished in accordance with the recommendations of the geotechnical engineer. Any loose or disturbed soils resulting from demolition should be removed or recompacted as engineered fill and any excavations should be backfilled in accordance with recommendations presented herein.

8.2 Site Clearing

Strip and remove any existing fill material, organic topsoil, vegetation, debris, collapsible soil and any other deleterious materials from the building, pool, pool deck, and sport court areas. The building area is defined as that area within the building footprint plus 5 feet beyond the perimeter of that footprint. All exposed surfaces should be free of mounds and depressions that could prevent uniform compaction.

8.3 Excavation

We anticipate that excavations for shallow foundations and utility trenches for the proposed construction can be accomplished with conventional equipment.

On-site silt and clay soils will pump or become unworkable at high water contents. Workability may be improved by scarifying and drying. In cold or wet weather, compaction may not be achievable in the clay soils. Over-excavation of wet zones and replacement with granular materials may be necessary. The use of lightweight excavation and compaction equipment may be required to minimize subgrade pumping.

The soils to be penetrated by the proposed excavations may vary significantly across the site. Our soil classifications are based solely on the materials encountered in widely spaced exploratory test borings. The contractor should verify that similar conditions exist throughout the proposed area of excavation. If different subsurface conditions are found at the time of construction, we should be contacted immediately to evaluate the conditions encountered.

8.4 Temporary Excavations and Slopes

Temporary, non-surcharged construction excavations should be sloped or shored. The individual contractor should be made responsible for designing and constructing stable, temporary excavations as required to maintain stability of both the excavation sides and bottom. All excavations should be sloped or shored in the interest of safety following local and federal regulations, including current OSHA excavation and trench safety standards. OSHA recommends a maximum slope inclination of ¾:1 (horizontal:vertical) for Type A soils, 1:1 for Type B soils, and 1½:1 for Type C soils.

As a safety measure, it is recommended that all vehicles and soil piles be kept a minimum lateral distance back from the crest of the slope at least equal to the slope height. The exposed slope face should be protected against the elements.

If any excavation, including a utility trench, is extended to a depth of more than 20 feet, it will be necessary to have the side slopes designed by a professional engineer.

We recommend that the contractor retain a geotechnical engineer to observe the soils exposed in all excavations and provide engineering design for the slopes. This will provide an opportunity to classify the soil types encountered, and to modify the excavation slopes as necessary. This also allows the opportunity to analyze the stability of the excavation slopes during construction.

8.5 Building Pad Preparation

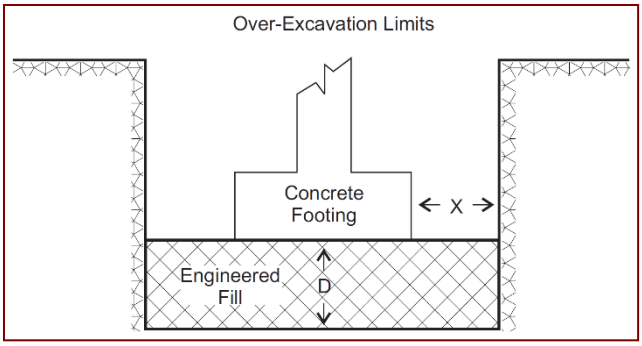
In order to limit the settlement potential in the building, pool, pool deck, and sport court areas. The existing collapsible soils should be removed and recompacted in a mass excavation in these areas. The depth of the collapsible soils is approximately 7 to 8 feet below the existing site grades. The removal and recompaction should extend to the same distance beyond the structures as the depth to suitable soils. The depth of the recompacted soils below footings should be a minimum of 3 feet and extend to native, non-collapsible soils.

8.6 Foundation Preparation

If the building pad preparation recommendations above are followed, footings should be placed directly upon the recompacted soil using the allowable bearing capacity for recompacted native soils.

If the higher bearing capacity is required, remove the native and or recompacted soils as required to a minimum depth as shown below the bottom of the footing depth D in the diagram below. Removal should extend a minimum of beyond the footing edges length X in as shown in the diagram below. Replace with imported engineered fill material.

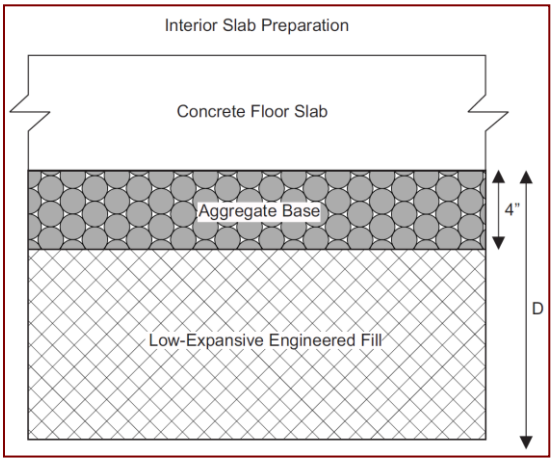
Footing Width (feet)	Depth D (feet)	Length X (feet)
<4	3	2
>4	4	3



Footings for individual structures should be placed all upon the recompacted native soil or all upon the imported engineered fill. Partial placement on the recompacted soil and imported soil is not allowed.

8.7 Conventional Interior Slab Preparation

Slabs-on-grade should be founded on engineered fill material over the recompacted native soils. Remove existing soils to a minimum depth of 12 inches below the bottom of the slab (depth D in the diagram below). Replace with properly compacted, imported engineered fill material. The aggregate base course or clean gravel below the slab may be included as part of the engineered fill.



8.8 Exterior Slab Preparation

Exterior sidewalks, paver areas and sport courts should be placed over recompacted native soils or engineered fill extending to native undisturbed soils.

The soils on this site have the potential to expand, shrink and collapse with changes in moisture content. In addition, frost penetration in the upper soils may cause surface heaving. Therefore, relatively lightweight exterior concrete flatwork such as sidewalks, patios, and driveways, may experience movements resulting in cracking or vertical offsets. To reduce the potential for damage, we recommend:

- Use of fill with low expansion potential
- Use of fill with low to negligible frost susceptibility
- Placement of effective control joints on relatively close centers
- Moisture-density control during placement of subgrade fills
- Provision for adequate drainage in areas adjoining the slabs
- Use of designs which allow vertical movement between the exterior slabs and adjoining structural elements

It should be understood that these recommendations will help reduce the potential for soil movement and resulting distress but will not eliminate this potential.

8.9 Pool Preparation

Remove any existing fill, organic soils, and collapsible soils to native non-collapsible soils. The depth of the removal should be a minimum of 2 feet below the bottom of the pool shell or to non-collapsible soils, whichever is greater. Imported untreated base should then be placed in lifts and compacted to 98 percent of a modified Proctor (ASTM 1557).

8.10 Pavement Preparation

The subgrade should be scarified, moistened as required, and recompacted for a minimum depth of 10 inches prior to placement of fill and pavement materials.

8.11 Wet/Unstable Subgrade Soils

If site soils become excessively wet, pumping and instability should be anticipated. If wet, unstable subgrade soils are encountered during construction, there are several alternatives to mitigate them. The alternatives vary in cost and time to implement, so the alternatives should be evaluated and compared in order to decide which one is most beneficial for the project.

1. The wet, unstable subgrade may be scarified and/or partially removed in order to allow the excess moisture to evaporate. The soils should be periodically blended to allow uniform drying to occur. When the soils are near optimum moisture content, they should be compacted in accordance with project requirements.

2. The wet, unstable subgrade may be removed and replaced with drier, granular soil and/or aggregate base course. The depth of removal necessary will vary depending on the conditions in each unstable area. It may be best to remove a uniform thickness of 2 feet in each area. Although the wet, unstable soils may extend to a depth greater than 2 feet, the granular material should bridge over these deeper wet soils. Removal should be performed with an excavator or similar piece of equipment so that underlying wet soils will not be adversely affected by wheel loads and thereby become more unstable. The first foot of granular backfill should be placed at near-optimum moisture content and compacted using static (non-vibrating) equipment to at least 90 percent of the maximum dry density. The second foot of granular material may then be placed and compacted in accordance with project requirements.

3. Geogrid and aggregate base course may be used to bridge over wet subgrade soils. Wet, unstable subgrade should be removed to a depth of at least 1 foot and to a distance at least 2 feet beyond the edge of the unstable area. Removal should be performed with an excavator or similar piece of equipment so that underlying wet soils will not be adversely affected by wheel loads and thereby become unstable. Geogrid should consist of Tensar TX-5 or equivalent and should be installed in accordance with the manufacturer's installation instructions. The geogrid should extend at least 2 feet beyond the edge of the unstable area. Aggregate base course (not just granular soil) should be placed over the geogrid and compacted in accordance with project requirements.

The extent of the unstable areas to be treated may be identified by proof rolling the exposed materials with a 20-ton, tandem-axle, dual-wheel water truck or dump truck loaded to the legal limit with tires inflated to 100 psi. Areas where soil movement is observed more than 6 inches away from the truck's rear tires should be considered unstable.

8.12 Materials

Imported engineered fill may be used as fill material for the following:

- Foundation areas
- Interior slab areas and sport court areas[7]
- Pavement areas
- Backfill

Recompacted native clay and silt soils may be used to support the structures provided they are compacted to the requirements for engineered fill and the lower bearing capacity is used for design. The native clay and silt soils may also be used in non-structural areas such as landscaping or below pavement subbase materials.

Materials used as engineered fill should be reasonably free of rock and lumps having a particle diameter greater than 6 inches. Acceptance of the quantity of oversized materials shall be at the discretion of the geotechnical engineer. Any required import material should consist of well drained granular material. All imported material should be approved prior to importing.

Frozen soils should not be used as fill or backfill.

Imported soils should conform to the following:

- Gradation (ASTM C136): percent finer by weight

6"	100
4"	85-100
¾"	70-95
No. 4 Sieve	50-85
No. 200 Sieve	11 (max)

Untreated Base course should conform to the American Public Works Association (APWA) *Manual of Standard Specifications,* current edition.

8.13 Placement and Compaction

[7] On-site clay and silt soils are not recommended for use within 12 inches of the bottom of slabs-on-grade or as structural backfill behind retaining walls.

a. Place and compact fill in horizontal lifts, using equipment and procedures that will produce recommended water contents and densities throughout the lift.

b. Uncompacted lift thickness should not exceed 10 inches. Thinner lifts may be required to achieve compaction in the clay and silt soils.

c. The clay and silt soils will require tight moisture control to achieve compaction. Soil work done in cold and wet weather conditions may require imported soils if compaction of the silt and clay soils is not achievable.

d. Materials should be compacted to the following:

Material	Minimum Percent Compaction (ASTM D1557)
• On-site or imported soil, reworked and fill:	
Below footings	95*
Below slabs-on-grade	95
Below pavement	95
• Untreated base course below slabs-on-grade and foundations	95
• Untreated base course below pool shells	98
• Aggregate base below pavement (private drives, parking areas)	95
• Nonstructural backfill	90

* Fill at depths greater than 5 feet below finished grade should be compacted to at least 98 percent of the ASTM D1557 dry-density value to within 5 feet of finished grade. Fill at depths less than 5 feet below finished grade should be compacted to the minimum values provided above.

On-site clayey soils should be compacted within a water content range of 1 percent below to 3 percent above optimum. Imported granular soils should be compacted within a water content range of 2 percent below to 3 percent above optimum.

8.14 Compliance

Recommendations for foundations, slabs-on-grade, and pavements supported on compacted fills or prepared subgrade depend upon compliance with the **EARTHWORK** recommendations. To assess compliance, observation and testing should be performed under the direction of a WT geotechnical engineer. Please contact us to provide these observation and testing services.

9.0 LIMITATIONS

This report has been prepared assuming the project criteria described in **2.0 PROJECT DESCRIPTION**. If changes in the project criteria occur, or if different subsurface conditions are encountered or become known, the conclusions and recommendations presented herein shall become invalid. In any such event, WT should be contacted in order to assess the effect that such variations may have on our conclusions and recommendations. If WT is not retained for the construction observation and testing services to determine compliance with this report, our professional responsibility is accordingly limited.

The recommendations presented are based entirely upon data derived from a limited number of samples obtained from widely spaced explorations. The attached logs are indicators of subsurface conditions only at the specific locations and times noted. This report assumes the uniformity of the geology and soil structure between explorations, however variations can and often do exist. Whenever any deviation, difference, or change is encountered or becomes known, WT should be contacted.

This report is for the exclusive benefit of our client alone. There are no intended third-party beneficiaries of our contract with the client or this report, and nothing contained in the contract or this report shall create any express or implied contractual or any other relationship with, or claim or cause of action for, any third party against WT.

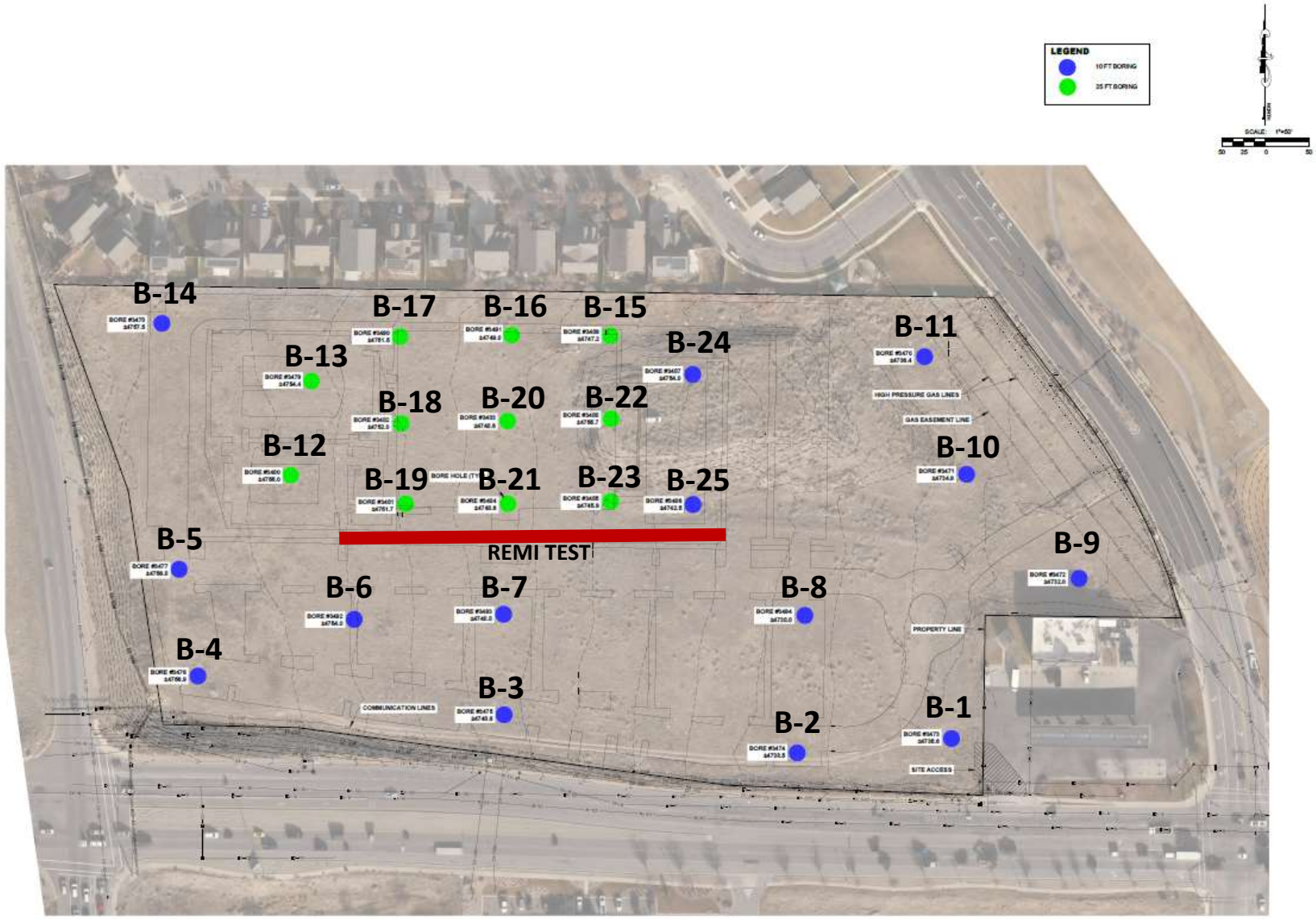
This report is valid for the earlier of one year from the date of issuance, a change in circumstances, or discovered variations. After expiration, no person or entity shall rely on this report without the express written authorization of WT.

10.0 CLOSURE

We prepared this report as an aid to the designers of the proposed project. The comments, statements, recommendations and conclusions set forth in this report reflect the opinions of the authors. These opinions are based upon data obtained at the location of the explorations, and from laboratory tests. Work on your project was performed in accordance with generally accepted standards and practices utilized by professionals providing similar services in this locality. No other warranty, express or implied, is made.



Western Technologies An RMA Company	PROJECT: LIFE TIME ATHLETIC COUNTRY CLUB – HERRIMAN REFERENCE NO.: 61-224216-0	PLATE 1
	VICINITY MAP	



Western Technologies
An RMA Company

PROJECT: LIFE TIME ATHELTIC COUNTRY CLUB - HERRIMAN

REFERENCE NO.: 61-224216-0

BORING LOCATION DIAGRAM

PLATE

2



Approximate Boring Locations/Depth of Collapsible Soils

CERTERRA
WESTERN TECHNOLOGIES

PROJECT: LIFE TIME ATHLETIC COUNTRY CLUB - HERRIMAN
REFERENCE NO.: 61-224216-0

ADDITIONAL BORING LOCATION DIAGRAM

PLATE

3

APPENDIX A

Allowable Soil Bearing Capacity	The recommended maximum contact stress developed at the interface of the foundation element and the supporting material.
Backfill	A specified material placed and compacted in a confined area.
Base Course	A layer of specified aggregate material placed on a subgrade or subbase.
Base Course Grade	Top of base course.
Bench	A horizontal surface in a sloped deposit.
Caisson/Drilled Shaft	A concrete foundation element cast in a circular excavation which may have an enlarged base (or belled caisson).
Concrete Slabs-On-Grade	A concrete surface layer cast directly upon base course, subbase or subgrade.
Crushed Rock Base Course	A base course composed of crushed rock of a specified gradation.
Differential Settlement	Unequal settlement between or within foundation elements of a structure.
Engineered Fill	Specified soil or aggregate material placed and compacted to specified density and/or moisture conditions under observations of a representative of a soil engineer.
Existing Fill	Materials deposited through the action of man prior to exploration of the site.
Existing Grade	The ground surface at the time of field exploration.
Expansive Potential	The potential of a soil to expand (increase in volume) due to absorption of moisture.
Fill	Materials deposited by the actions of man.
Finished Grade	The final grade created as a part of the project.
Gravel Base Course	A base course composed of naturally occurring gravel with a specified gradation.
Heave	Upward movement.
Native Grade	The naturally occurring ground surface.
Native Soil	Naturally occurring on-site soil.
Rock	A natural aggregate of mineral grains connected by strong and permanent cohesive forces. Usually requires drilling, wedging, blasting or other methods of extraordinary force for excavation.
Sand and Gravel Base Course	A base course of sand and gravel of a specified gradation.
Sand Base Course	A base course composed primarily of sand of a specified gradation.
Scarify	To mechanically loosen soil or break down existing soil structure.
Settlement	Downward movement.
Soil	Any unconsolidated material composed of discrete solid particles, derived from the physical and/or chemical disintegration of vegetable or mineral matter, which can be separated by gentle mechanical means such as agitation in water.
Strip	To remove from present location.
Subbase	A layer of specified material placed to form a layer between the subgrade and base course.
Subbase Grade	Top of subbase.
Subgrade	Prepared native soil surface.

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COARSE-GRAINED SOILS

LESS THAN 50% FINES

GROUP SYMBOLS	DESCRIPTION	MAJOR DIVISIONS
GW	WELL-GRADED GRAVEL OR WELL-GRADED GRAVEL WITH SAND, LESS THAN 5% FINES	GRAVELS MORE THAN HALF OF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE SIZE
GP	POORLY-GRADED GRAVEL OR POORLY-GRADED GRAVEL WITH SAND, LESS THAN 5% FINES	
GM	SILTY GRAVEL OR SILTY GRAVEL WITH SAND, MORE THAN 12% FINES	
GC	CLAYEY GRAVEL OR CLAYEY GRAVEL WITH SAND, MORE THAN 12% FINES	
SW	WELL-GRADED SAND OR WELL-GRADED SAND WITH GRAVEL, LESS THAN 5% FINES	SANDS MORE THAN HALF OF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE SIZE
SP	POORLY-GRADED SAND OR POORLY-GRADED SAND WITH GRAVEL, LESS THAN 5% FINES	
SM	SILTY SAND OR SILTY SAND WITH GRAVEL, MORE THAN 12% FINES	
SC	CLAYEY SAND OR CLAYEY SAND WITH GRAVEL, MORE THAN 12% FINES	

NOTE: Coarse-grained soils receive dual symbols if they contain 5% to 12% fines (e.g., SW-SM, GP-GC).

FINE-GRAINED SOILS

MORE THAN 50% FINES

GROUP SYMBOLS	DESCRIPTION	MAJOR DIVISIONS
ML	SILT, SILT WITH SAND OR GRAVEL, SANDY SILT, OR GRAVELLY SILT	SILTS AND CLAYS LIQUID LIMIT LESS THAN 50
CL	LEAN CLAY OF LOW TO MEDIUM PLASTICITY, SANDY CLAY, OR GRAVELLY CLAY	
OL	ORGANIC SILT OR ORGANIC CLAY OF LOW TO MEDIUM PLASTICITY	
MH	ELASTIC SILT, SANDY ELASTIC SILT, OR GRAVELLY ELASTIC SILT	SILTS AND CLAYS LIQUID LIMIT MORE THAN 50
CH	FAT CLAY OF HIGH PLASTICITY, SANDY FAT CLAY, OR GRAVELLY FAT CLAY	
OH	ORGANIC SILT OR ORGANIC CLAY OF HIGH PLASTICITY	
PT	PEAT AND OTHER HIGHLY ORGANIC SOILS	HIGHLY ORGANIC SOILS

NOTE: Fine-grained soils may receive dual classification based upon plasticity characteristics (e.g. CL-ML).

SOIL SIZES

COMPONENT	SIZE RANGE
BOULDERS	Above 12 in.
COBBLES	3 in. – 12 in.
GRAVEL	No. 4 – 3 in.
Coarse	¾ in. – 3 in.
Fine	No. 4 – ¾ in.
SAND	No. 200 – No. 4
Coarse	No. 10 – No. 4
Medium	No. 40 – No. 10
Fine	No. 200 – No. 40
Fines (Silt or Clay)	Below No. 200

NOTE: Only sizes smaller than three inches are used to classify soils

CONSISTENCY

CLAYS & SILTS	BLOWS PER FOOT
VERY SOFT	0 – 2
SOFT	3 – 4
FIRM	5 – 8
STIFF	9 – 15
VERY STIFF	16 – 30
HARD	OVER 30

RELATIVE DENSITY

SANDS & GRAVELS	BLOWS PER FOOT
VERY LOOSE	0 – 4
LOOSE	5 – 10
MEDIUM DENSE	11 – 30
DENSE	31 – 50
VERY DENSE	OVER 50

NOTE: Number of blows using 140-pound hammer falling 30 inches to drive a 2-inch-OD (1⅜-inch ID) split-barrel sampler (ASTM D1586).

PLASTICITY OF FINE GRAINED SOILS

PLASTICITY INDEX	TERM
0	NON-PLASTIC
1 – 7	LOW
8 – 20	MEDIUM
Over 20	HIGH

DEFINITION OF WATER CONTENT

DRY
SLIGHTLY DAMP
DAMP
MOIST
WET
SATURATED

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The number shown in **"BORING NO."** refers to the approximate location of the same number indicated on the "Boring Location Diagram" as positioned in the field by pacing or measurement from property lines and/or existing features, or through the use of Global Positioning System (GPS) devices. The accuracy of GPS devices is somewhat variable.

"DRILLING TYPE" refers to the exploratory equipment used in the boring wherein **HSA = hollow stem auger**, and the dimension presented is the outside diameter of the HSA used.

"N" in "BLOW COUNTS" refers to a 2-inch outside diameter split-barrel sampler driven into the ground with a 140 pound drop-hammer dropped 30 inches repeatedly until a penetration of 18 inches is achieved or until refusal. The number of blows, or "blow count", of the hammer is recorded for each of three 6-inch increments totaling 18 inches. The number of blows required for advancing the sampler for the last 12 inches (2nd and 3rd increments) is defined as the Standard Penetration Test (SPT) "**N**"-Value. Refusal to penetration is considered more than 50 blows per 6 inches. (Ref. ASTM D1586).

"R" in "BLOW COUNTS" refers to a 3-inch outside diameter ring-lined split barrel sampler driven into the ground with a 140 pound drop-hammer dropped 30 inches repeatedly until a penetration of 12 inch is achieved or until refusal. The number of blows required to advance the sampler 12 inches is defined as the "**R**" blow count. The "**R**" blow count requires an engineered conversion to an equivalent SPT N-Value. Refusal to penetration is considered more than 50 blows per foot. (Ref. ASTM D3550).

"CS" in "BLOWS/FT." refers to a 2½-in. outside diameter California style split-barrel sampler, lined with brass sleeves, driven into the ground with a 140-pound hammer dropped 30 inches repeatedly until a penetration of 18 inches is achieved or until refusal. The number of blows of the hammer is recorded for each of the three 6-inch increments totaling 18 inches. The number of blows required for advancing the sampler for the last 12 inches (2nd and 3rd increments) is defined as the "CS" blow count. The "CS" blow count requires an engineered conversion to an equivalent SPT N-Value. Refusal to penetration is considered more than 50 blows for a 6-inch increment. (Ref. ASTM D 3550)

"SAMPLE TYPE" refers to the form of sample recovery, in which **N** = Split-barrel sample, **R** = Ring-lined sample, **"CS"** = California style split-barrel sample, **G** = Grab sample, **B** = Bucket sample, **C** = Core sample (ex. diamond bit rock coring).

"DRY DENSITY (LBS/CU FT)" refers to the laboratory-determined dry density in pounds per cubic foot. The symbol **"NR"** indicates that no sample was recovered.

"WATER (MOISTURE) CONTENT" (% of Dry Wt.) refers to the laboratory-determined water content in percent using the standard test method ASTM D2216.

"USCS" refers to the "Unified Soil Classification System" Group Symbol for the soil type as defined by ASTM D2487 and D2488. The soils were classified visually in the field, and where appropriate, classifications were modified by visual examination of samples in the laboratory and/or by appropriate tests.

These notes and boring logs are intended for use in conjunction with the purposes of our services defined in the text. Boring log data should not be construed as part of the construction plans nor as defining construction conditions.

Boring logs depict our interpretations of subsurface conditions at the locations and on the date(s) noted. Variations in subsurface conditions and characteristics may occur between borings. Groundwater levels may fluctuate due to seasonal variations and other factors.

The stratification lines shown on the boring logs represent our interpretation of the approximate boundary between soil or rock types based upon visual field classification at the boring location. The transition between materials is approximate and may be more or less gradual than indicated.

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Project: Life Time Athletic Country Club
Project Location: Herriman, UT
Project Number: 61-224216-0

Key to Boring Logs

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DEPTH (FEET)	MOISTURE CONTENT	DRY DENSITY (LBS/CU FT)	SAMPLE TYPE	SAMPLE	BLOW COUNTS	USCS	GRAPHIC	SOIL DESCRIPTION	REMARKS AND OTHER TESTS
1	2	3	4	5	6	7	8	9	10

COLUMN DESCRIPTIONS

1. DEPTH (FEET): Depth in feet below the ground surface.
2. MOISTURE CONTENT (% OF DRY WT.): Water content of the soil sample, expressed as percentage of dry weight of sample.
3. DRY DENSITY (LBS/CU FT): Dry weight per unit volume of soil sample measured in laboratory, in pounds per cubic foot.
4. SAMPLE TYPE: Sample identification letter.
5. SAMPLE: Soil type symbol.
6. BLOW COUNTS: Number of blows to advance driven sampler one foot (or distance shown) beyond seating interval using the hammer identified on the boring log.
7. USCS: Type of material encountered.
8. GRAPHIC: Graphic depiction of the subsurface material encountered.
9. SOIL DESCRIPTION: Description of material encountered. May include consistency, moisture, color, and other descriptive text.
10. REMARKS AND OTHER TESTS: Comments and observations regarding drilling or sampling made by driller or field personnel.

FIELD AND LABORATORY TEST ABBREVIATIONS

CHEM: Chemical tests to assess corrosivity
COMP: Compaction test
CONS: One-dimensional consolidation test
LL: Liquid Limit, percent
PI: Plasticity Index, percent
SA: Sieve analysis (percent passing No. 200 Sieve)
UC: Unconfined compressive strength test, Qu, in ksf
WA: Wash sieve (percent passing No. 200 Sieve)

MATERIAL GRAPHIC SYMBOLS

- Fat CLAY, CLAY w/SAND, SANDY CLAY (CH)
- Lean CLAY, CLAY w/SAND, SANDY CLAY (CL)
- Clayey GRAVEL (GC)
- Silty GRAVEL (GM)
- Poorly graded GRAVEL (GP)
- Poorly graded GRAVEL with Silt (GP-GM)
- SILT, SILT w/SAND, SANDY SILT (MH)
- SILT, SILT w/SAND, SANDY SILT (ML)
- Clayey SAND (SC)
- Silty SAND (SM)
- Poorly graded SAND (SP)
- Poorly graded SAND with Clay (SP-SC)
- Poorly graded SAND with Silt (SP-SM)

TYPICAL SAMPLER GRAPHIC SYMBOLS

- Auger sampler
- Bulk Sample
- 3-inch-OD California w/ brass rings
- CME Sampler
- Grab Sample
- 2.5-inch-OD Modified California w/ brass liners
- Pitcher Sample
- 2-inch-OD unlined split spoon (SPT)
- Shelby Tube (Thin-walled, fixed head)

OTHER GRAPHIC SYMBOLS

- Water level (at time of drilling, ATD)
- Water level (after waiting, AW)
- Minor change in material properties within a stratum
- Inferred/gradational contact between strata
- Queried contact between strata

GENERAL NOTES

1: Soil classifications are based on the Unified Soil Classification System. Descriptions and stratum lines are interpretive, and actual lithologic changes may be gradual. Field descriptions may have been modified to reflect results of lab tests.
2: Descriptions on these logs apply only at the specific boring locations and at the time the borings were advanced. They are not warranted to be representative of subsurface conditions at other locations or times.

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PLATE NO. A-4

Project: Life Time Athletic Country Club **Project Location:** Herriman, UT **Project Number:** 61-224216-0	**BORING NO. B-1**	Western Technologies An RMA Company

Date Logged **01/20/25**	Logged By **Michelle Humberg**	Checked By **Warren Clyde**
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type **7 inch/Hollow Stem Auger**	Total Depth **11.5 feet bgs**
Drill Rig Type **Mobile B-80**	Drilling Contractor **EARTHCORE**	
Groundwater **Groundwater Not Encountered**	Sampling Method(s) **Modified California**	
Bore Hole Backfill **Drill Cuttings**	Location **See Boring Location Diagram**	

DEPTH (FEET)	MOISTURE CONTENT	DRY DENSITY (LBS/CU FT)	SAMPLE TYPE	SAMPLE	BLOW COUNTS	USCS	GRAPHIC	SOIL DESCRIPTION	REMARKS AND OTHER TESTS
0						TOPSOIL		TOPSOIL; clay with sand, brown, slightly damp, organics in top 6 inches	
						CL			
	16.0		CS		31			CLAY; some sand, brown, very stiff, slightly damp	
5						CH			
	27.9		CS		35			FAT CLAY; trace sand, light brown, very stiff, slightly damp, pinholes	
			CS		46	CL		CLAY; with sand, brown, hard, damp	
10			CS		50-4"	SP		SAND; with gravel, brown, very dense, slightly damp	
								BORING TERMINATED AT 11.5 FEET	
15									
20									
25									
30									

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PLATE NO. A-5

Project: Life Time Athletic Country Club **Project Location:** Herriman, UT **Project Number:** 61-224216-0	**BORING NO. B-2**	Western Technologies An RMA Company

Date Logged **01/20/25**	Logged By **Michelle Humberg**	Checked By **Warren Clyde**
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type **7 inch/Hollow Stem Auger**	Total Depth **11.5 feet bgs**
Drill Rig Type **Mobile B-80**	Drilling Contractor **EARTHCORE**	
Groundwater **Groundwater Not Encountered**	Sampling Method(s) **SPT**	
Bore Hole Backfill **Drill Cuttings**	Location **See Boring Location Diagram**	

DEPTH (FEET)	MOISTURE CONTENT	DRY DENSITY (LBS/CU FT)	SAMPLE TYPE	SAMPLE	BLOW COUNTS	USCS	GRAPHIC	SOIL DESCRIPTION	REMARKS AND OTHER TESTS
0						Topsoil		TOPSOIL; clay with sand, brown, slightly damp, organics in top 6 inches	
						CL			
			N		11			CLAY; brown & white, stiff, slightly damp	
5			N		71	SP-SC		CLAYEY SAND; with gravel, brown, very dense, slightly damp	
			N		50-3"			...grading to SAND; with clay and gravel, damp	
10			N		54			...grading to GRAVELLEY SAND; light brown	
								BORING TERMINATED AT 11.5 FEET	
15									
20									
25									
30									

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PLATE NO. A-6

Project: Life Time Athletic Country Club **Project Location:** Herriman, UT **Project Number:** 61-224216-0	**BORING NO. B-3**	Western Technologies An RMA Company

Date Logged **01/20/25**	Logged By **Michelle Humberg**	Checked By **Warren Clyde**
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type **7 inch/Hollow Stem Auger**	Total Depth **11.5 feet bgs**
Drill Rig Type **Mobile B-80**	Drilling Contractor **EARTHCORE**	
Groundwater **Groundwater Not Encountered**	Sampling Method(s) **Modified California**	
Bore Hole Backfill **Drill Cuttings**	Location **See Boring Location Diagram**	

DEPTH (FEET)	MOISTURE CONTENT	DRY DENSITY (LBS/CU FT)	SAMPLE TYPE	SAMPLE	BLOW COUNTS	USCS	GRAPHIC	SOIL DESCRIPTION	REMARKS AND OTHER TESTS
0						TOPSOIL		TOPSOIL; clay with sand, brown, damp, organics in the top 6 inches	
						ML			
	30.1		CS		11			SILT; some sand, brown with white streaks, stiff, damp	
5	28.8		CS		12			...brown, oxide stains	
			CS		7	CL		CLAY; light brown with white streaks, firm, damp	
10			CS		42			...grading to SANDY CLAY; brown, oxide stains, hard	
								BORING TERMINATED AT 11.5 FEET	
15									
20									
25									
30									

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PLATE NO. A-7

Project: Life Time Athletic Country Club **Project Location:** Herriman, UT **Project Number:** 61-224216-0	**BORING NO. B-4**	Western Technologies An RMA Company

Date Logged **01/20/25**	Logged By **Michelle Humberg**	Checked By **Warren Clyde**
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type **7 inch/Hollow Stem Auger**	Total Depth **11.5 feet bgs**
Drill Rig Type **Mobile B-80**	Drilling Contractor **EARTHCORE**	
Groundwater **Groundwater Not Encountered**	Sampling Method(s) **SPT**	
Bore Hole Backfill **Drill Cuttings**	Location **See Boring Location Diagram**	

DEPTH (FEET)	MOISTURE CONTENT	DRY DENSITY (LBS/CU FT)	SAMPLE TYPE	SAMPLE	BLOW COUNTS	USCS	GRAPHIC	SOIL DESCRIPTION	REMARKS AND OTHER TESTS
0						TOPSOIL		TOPSOIL; clay with sand, brown, damp, organics in the top 6 inches	
						ML			
	25.4		N		6			SILT; some sand, brown with white streaks, firm, slightly damp	
5	21.3		N		9			...brown, stiff, damp	
	49.3		N		5	MH		ELASTIC SILT; some sand, trace gravel, brown, oxide stains, firm, damp	
10			N		9	CL		CLAY; with sand, brown, oxide stains, stiff, moist	
								BORING TERMINATED AT 11.5 FEET	
15									
20									
25									
30									

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PLATE NO. A-8

Project: Life Time Athletic Country Club **Project Location:** Herriman, UT **Project Number:** 61-224216-0	**BORING NO. B-5**	Western Technologies An RMA Company

Date Logged **01/20/25**	Logged By **Michelle Humberg**	Checked By **Warren Clyde**
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type **7 inch/Hollow Stem Auger**	Total Depth **11.5 feet bgs**
Drill Rig Type **Mobile B-80**	Drilling Contractor **EARTHCORE**	
Groundwater **Groundwater Not Encountered**	Sampling Method(s) **Modified California**	
Bore Hole Backfill **Drill Cuttings**	Location **See Boring Location Diagram**	

DEPTH (FEET)	MOISTURE CONTENT	DRY DENSITY (LBS/CU FT)	SAMPLE TYPE	SAMPLE	BLOW COUNTS	USCS	GRAPHIC	SOIL DESCRIPTION	REMARKS AND OTHER TESTS
0						TOPSOIL		TOPSOIL; clay with sand, brown, damp, organics in the top 6 inches	
						ML			
	11.6		CS		13			SILT; some sand, light brown, stiff, slightly damp	
5	13.4		CS		15			...brown with white streaks	
			CS		17	CL		CLAY; brown with white streaks, stiff, slightly damp	
10			CS		17			...brown, oxide stains, damp	
								BORING TERMINATED AT 11.5 FEET	
15									
20									
25									
30									

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PLATE NO. A-9

Project: Life Time Athletic Country Club **Project Location:** Herriman, UT **Project Number:** 61-224216-0	**BORING NO. B-6**	Western Technologies An RMA Company

Date Logged **01/20/25**	Logged By **Michelle Humberg**	Checked By **Warren Clyde**
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type **7 inch/Hollow Stem Auger**	Total Depth **11.5 feet bgs**
Drill Rig Type **Mobile B-80**	Drilling Contractor **EARTHCORE**	
Groundwater **Groundwater Not Encountered**	Sampling Method(s) **SPT**	
Bore Hole Backfill **Drill Cuttings**	Location **See Boring Location Diagram**	

DEPTH (FEET)	MOISTURE CONTENT	DRY DENSITY (LBS/CU FT)	SAMPLE TYPE	SAMPLE	BLOW COUNTS	USCS	GRAPHIC	SOIL DESCRIPTION	REMARKS AND OTHER TESTS
0						TOPSOIL		TOPSOIL; clay with sand, brown, damp, organics in the top 6 inches	
						ML			
	29.5		N		8			SILT; some sand, trace gravel, brown with white streaks, firm, slightly damp	
5	26.8		N		10			...some sand, brown, stiff	
			N		10	CL		CLAY; brown, stiff, damp	
10			N		5			...oxide stains, firm	
								BORING TERMINATED AT 11.5 FEET	
15									
20									
25									
30									

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PLATE NO. A-10

Project: Life Time Athletic County Club **Project Location:** Herriman, UT **Project Number:** 61-224216	**BORING NO. B-7**	Western Technologies An RMA Company

Date Logged **01/20/25**	Logged By **Michelle Humberg**	Checked By **Warren Clyde**
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type **7 inch/Hollow Stem Auger**	Total Depth **11.5 feet bgs**
Drill Rig Type **Mobile B-80**	Drilling Contractor **EARTHCORE**	
Groundwater **Groundwater Not Encountered**	Sampling Method(s) **Modified California**	
Bore Hole Backfill **Drill Cuttings**	Location **See Boring Location Diagram**	

DEPTH (FEET)	MOISTURE CONTENT	DRY DENSITY (LBS/CU FT)	SAMPLE TYPE	SAMPLE	BLOW COUNTS	USCS	GRAPHIC	SOIL DESCRIPTION	REMARKS AND OTHER TESTS
0						TOPSOIL		TOPSOIL; clay with sand, brown, damp, organics in the top 6 inches	
						ML			
	18.8		CS		10			SILT; some sand, brown with white streaks, firm, slightly damp	
5	19.7		CS		19			...some sand, trace gravel, brown, very stiff	
			CS		12	CL		SANDY CLAY; brown and white, oxide stains, stiff, slightly damp	
10			CS		20	SM		SILTY SAND; brown, oxide stains, medium dense, slightly damp	
								BORING TERMINATED AT 11.5 FEET	
15									
20									
25									
30									

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PLATE NO. A-11

Project: Life Time Athletic Country Club **Project Location:** Herriman, UT **Project Number:** 61-224216-0	**BORING NO. B-8**	Western Technologies An RMA Company

Date Logged **01/20/25**	Logged By **Michelle Humberg**	Checked By **Warren Clyde**
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type **7 inch/Hollow Stem Auger**	Total Depth **11.5 feet bgs**
Drill Rig Type **Mobile B-80**	Drilling Contractor **EARTHCORE**	
Groundwater **Groundwater Not Encountered**	Sampling Method(s) **SPT**	
Bore Hole Backfill **Drill Cuttings**	Location **See Boring Location Diagram**	

DEPTH (FEET)	MOISTURE CONTENT	DRY DENSITY (LBS/CU FT)	SAMPLE TYPE	SAMPLE	BLOW COUNTS	USCS	GRAPHIC	SOIL DESCRIPTION	REMARKS AND OTHER TESTS
0						TOPSOIL		TOPSOIL; clay with sand, brown, damp, organics in the top 6 inches	
						CL			
			N		13			CLAY; brown and white streaks, stiff, slightly damp	
5			N		5			...grading to SANDY CLAY; brown, firm	
			N		30	SC		CLAYEY SAND; brown and white, medium dense, slightly damp	
10			N		28	SM		SILTY SAND; with gravel, brown and white, medium dense, slightly damp	
								BORING TERMINATED AT 11.5 FEET	
15									
20									
25									
30									

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PLATE NO. A-12

Project: Life Time Athletic Country Club **Project Location:** Herriman, UT **Project Number:** 61-224216-0	**BORING NO. B-9**	Western Technologies An RMA Company

Date Logged **01/20/25**	Logged By **Michelle Humberg**	Checked By **Warren Clyde**
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type **7 inch/Hollow Stem Auger**	Total Depth **11.5 feet bgs**
Drill Rig Type **Mobile B-80**	Drilling Contractor **EARTHCORE**	
Groundwater **Groundwater Not Encountered**	Sampling Method(s) **Modified California**	
Bore Hole Backfill **Drill Cuttings**	Location **See Boring Location Diagram**	

DEPTH (FEET)	MOISTURE CONTENT	DRY DENSITY (LBS/CU FT)	SAMPLE TYPE	SAMPLE	BLOW COUNTS	USCS	GRAPHIC	SOIL DESCRIPTION	REMARKS AND OTHER TESTS
0						TOPSOIL		TOPSOIL; clay with sand, brown, damp, organics in the top 6 inches	
						CL			
	12.8		CS		21			CLAY; trace sand, light brown, very stiff, slightly damp	
5						GM			
	5.2		CS		50			SILTY GRAVEL; some sand, light brown, dense, slightly damp	
						SM			
			CS		42			SILTY SAND; with gravel, light brown, dense, slightly damp	
10						GP-GM			
			CS		89-11"			SANDY GRAVEL; with silt, light brown, very dense, slightly damp	
								BORING TERMINATED AT 11.5 FEET	
15									
20									
25									
30									

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PLATE NO. A-13

Project: Life Time Athletic Country Club **Project Location:** Herriman, UT **Project Number:** 61-224216-0	**BORING NO. B-10**	Western Technologies An RMA Company

Date Logged **01/20/25**	Logged By **Michelle Humberg**	Checked By **Warren Clyde**
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type **7 inch/Hollow Stem Auger**	Total Depth **11.5 feet bgs**
Drill Rig Type **Mobile B-80**	Drilling Contractor **EARTHCORE**	
Groundwater **Groundwater Not Encountered**	Sampling Method(s) **SPT**	
Bore Hole Backfill **Drill Cuttings**	Location **See Boring Location Diagram**	

DEPTH (FEET)	MOISTURE CONTENT	DRY DENSITY (LBS/CU FT)	SAMPLE TYPE	SAMPLE	BLOW COUNTS	USCS	GRAPHIC	SOIL DESCRIPTION	REMARKS AND OTHER TESTS
0						TOPSOIL		TOPSOIL; clay with sand, brown, damp, organics in the top 6 inches	
						CL			
	17.8		N		3			CLAY; some sand, trace gravel, brown, soft, slightly damp	
5						CH			
	36.6		N		7			FAT CLAY; some sand, brown, firm, slightly damp	
			N		52	SM		SILTY SAND; with gravel, light gray, dense, slightly damp	
10						SP-SM			
			N		49			GRAVELLEY SAND; with silt, brown, dense, slightly damp	
								BORING TERMINATED AT 11.5 FEET	
15									
20									
25									
30									

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PLATE NO. A-14

Project: Life Time Athletic Country Club **Project Location:** Herriman, UT **Project Number:** 61-224216-0	**BORING NO. B-11**	Western Technologies An RMA Company

Date Logged **01/20/25**	Logged By **Michelle Humberg**	Checked By **Warren Clyde**
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type **7 inch/Hollow Stem Auger**	Total Depth **11.5 feet bgs**
Drill Rig Type **Mobile B-80**	Drilling Contractor **EARTHCORE**	
Groundwater **Groundwater Not Encountered**	Sampling Method(s) **Modified California**	
Bore Hole Backfill **Drill Cuttings**	Location **See Boring Location Diagram**	

DEPTH (FEET)	MOISTURE CONTENT	DRY DENSITY (LBS/CU FT)	SAMPLE TYPE	SAMPLE	BLOW COUNTS	USCS	GRAPHIC	SOIL DESCRIPTION	REMARKS AND OTHER TESTS
0						TOPSOIL		TOPSOIL; clay with sand, brown, damp, organics in the top 6 inches	
						CL		CLAY; trace sand, brown, stiff, slightly damp	
	23.4	82.6	CS		15				
5								...with sand and gravel	
	29.5		CS		15				
			CS		88	GP-GM		SANDY GRAVEL; with silt, brown and gray, very dense, slightly damp	
10						CL		CLAY; with sand and gravel, light brown, hard, slightly damp	
			CS		72				
								BORING TERMINATED AT 11.5 FEET	
15									
20									
25									
30									

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PLATE NO. A-15

Project: Life Time Athletic Country Club **Project Location:** Herriman, UT **Project Number:** 61-224216-0	**BORING NO. B-12**	Western Technologies An RMA Company

Date Logged **01/21/25**	Logged By **Michelle Humberg**	Checked By **Warren Clyde**
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type **7 inch/Hollow Stem Auger**	Total Depth **26.5 feet bgs**
Drill Rig Type **Mobile B-80**	Drilling Contractor **EARTHCORE**	
Groundwater **Groundwater Not Encountered**	Sampling Method(s) **SPT**	
Bore Hole Backfill **Drill Cuttings**	Location **See Boring Location Diagram**	

DEPTH (FEET)	MOISTURE CONTENT	DRY DENSITY (LBS/CU FT)	SAMPLE TYPE	SAMPLE	BLOW COUNTS	USCS	GRAPHIC	SOIL DESCRIPTION	REMARKS AND OTHER TESTS
0						TOPSOIL		TOPSOIL; clay with sand, brown, damp, organics in the top 6 inches	
						CL			
			N		5			SANDY CLAY; light brown, firm, slightly damp	
5	9.5	82.4	N		5			...grading to CLAY; some sand trace gravel	
	18.6	99.1	N		14			...trace sand, brown, stiff, damp	
10	39.4	69.3	N		18	MH		ELASTIC SILT; some sand, light brown, oxide stains, very stiff, organics	
15	14.6	109.1	N		12	CL		SANDY CLAY; brown, stiff, damp	
20	3.5		N		43	GM		SILTY SANDY GRAVEL; brown and gray, dense, slightly damp	
25	14.6	114.0	N		16	GC		CLAYEY SANDY GRAVEL; brown, medium dense, damp	
								BORING TERMINATED AT 26.5 FEET	
30									

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PLATE NO. A-16

Project: Life Time Athletic Country Club **Project Location:** Herriman, UT **Project Number:** 61-224216-0	**BORING NO. B-13**	Western Technologies An RMA Company

Date Logged **01/21/25**	Logged By **Michelle Humberg**	Checked By **Warren Clyde**
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type **7 inch/Hollow Stem Auger**	Total Depth **26.5 feet bgs**
Drill Rig Type **Mobile B-80**	Drilling Contractor **EARTHCORE**	
Groundwater **Groundwater Not Encountered**	Sampling Method(s) **SPT**	
Bore Hole Backfill **Drill Cuttings**	Location **See Boring Location Diagram**	

DEPTH (FEET)	MOISTURE CONTENT	DRY DENSITY (LBS/CU FT)	SAMPLE TYPE	SAMPLE	BLOW COUNTS	USCS	GRAPHIC	SOIL DESCRIPTION	REMARKS AND OTHER TESTS
0						TOPSPOIL		TOPSOIL; clay with sand, brown, damp, organics in the top 6 inches	
						ML			
	24.5		N		8			SILT; some sand, some gravel, brown with white streaks, firm, slightly damp	
5						CL			
	23.9		N		10			CLAY; some sand, brown, stiff, slightly damp	
	25.1		N		12			...trace sand, brown with white streaks, oxide stains	
10						CH			
	61.1		N		7			FAT CLAY; trace sand, brown, firm, damp	
15						CL			
	20.0		N		16			CLAY; some sand, brown with white streaks, stiff, damp	
20						SM			
	7.8		N		29			SILTY GRAVELLY SAND; brown, medium dense, damp	
25						GP-GM			
	4.8		N		32			SANDY GRAVEL; with silt, light brown, dense, slightly damp	
								BORING TERMINATED AT 26.5 FEET	
30									

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PLATE NO. A-17

Project: Life Time Athletic Country Club **Project Location:** Herriman, UT **Project Number:** 61-224216-0	**BORING NO. B-14**	Western Technologies An RMA Company

Date Logged **01/21/25**	Logged By **Michelle Humberg**	Checked By **Warren Clyde**
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type **7 inch/Hollow Stem Auger**	Total Depth **11.5 feet bgs**
Drill Rig Type **Mobile B-80**	Drilling Contractor **EARTHCORE**	
Groundwater **Groundwater Not Encountered**	Sampling Method(s) **Modified California**	
Bore Hole Backfill **Drill Cuttings**	Location **See Boring Location Diagram**	

DEPTH (FEET)	MOISTURE CONTENT	DRY DENSITY (LBS/CU FT)	SAMPLE TYPE	SAMPLE	BLOW COUNTS	USCS	GRAPHIC	SOIL DESCRIPTION	REMARKS AND OTHER TESTS
0						TOPSOIL		TOPSOIL; clay with sand, brown, damp, organics in the top 6 inches	
						ML			
	29.8	72.8	CS		13			SILT; some sand, trace gravel, brown with white streaks, stiff, slightly damp	
5	26.6	80.2	CS		9			...firm	
			CS		10	CL		CLAY; brown, oxide stains, firm, moist	
10			CS		9			...brown	
								BORING TERMINATED AT 11.5 FEET	
15									
20									
25									
30									

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PLATE NO. A-18

Project: Life Time Athletic Country Club **Project Location:** Herriman, UT **Project Number:** 61-224216-0	**BORING NO. B-15**	Western Technologies An RMA Company

Date Logged **01/21/25**	Logged By **Michelle Humberg**	Checked By **Warren Clyde**
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type **7 inch/Hollow Stem Auger**	Total Depth **26.5 feet bgs**
Drill Rig Type **Mobile B-80**	Drilling Contractor **EARTHCORE**	
Groundwater **Groundwater Not Encountered**	Sampling Method(s) **SPT**	
Bore Hole Backfill **Drill Cuttings**	Location **See Boring Location Diagram**	

DEPTH (FEET)	MOISTURE CONTENT	DRY DENSITY (LBS/CU FT)	SAMPLE TYPE	SAMPLE	BLOW COUNTS	USCS	GRAPHIC	SOIL DESCRIPTION	REMARKS AND OTHER TESTS
0						TOPSOIL		TOPSOIL; clay with sand, brown, damp, organics in the top 6 inches	
						ML			
	29.7		N		9			SILT; some sand, trace gravel, brown with white streaks, stiff, slightly damp	
5						CL		CLAY; some sand, brown, firm, slightly damp	
	28.2		N		8				
	74.7		N		2	CH		FAT CLAY; some sand, brown, very soft, damp	
10						SC		CLAYEY GRAVELLY SAND; brown and white, oxide stains, loose, damp	
	24.5		N		9				
15						GP-GM		SANDY GRAVEL; with silt, light brown, oxide stains, dense, damp	
	3.1		N		43				
20						SC		CLAYEY SAND; with gravel, brown, medium dense, damp	
	9.5		N		13				
25						GP		SANDY GRAVEL; brown, very dense, slightly damp	
			N		87				
								BORING TERMINATED AT 26.5 FEET	
30									

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PLATE NO. A-19

Project: Life Time Athletic Country Club **Project Location:** Herriman, UT **Project Number:** 61-224216-0	**BORING NO. B-16**	Western Technologies An RMA Company

Date Logged **01/21/25**	Logged By **Michelle Humberg**	Checked By **Warren Clyde**
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type **7 inch/Hollow Stem Auger**	Total Depth **26.5 feet bgs**
Drill Rig Type **Mobile B-80**	Drilling Contractor **EARTHCORE**	
Groundwater **Groundwater Not Encountered**	Sampling Method(s) **Modified California**	
Bore Hole Backfill **Drill Cuttings**	Location **See Boring Location Diagram**	

DEPTH (FEET)	MOISTURE CONTENT	DRY DENSITY (LBS/CU FT)	SAMPLE TYPE	SAMPLE	BLOW COUNTS	USCS	GRAPHIC	SOIL DESCRIPTION	REMARKS AND OTHER TESTS
0						TOPSOIL		TOPSOIL; clay with sand, brown, damp, organics in the top 6 inches	
						CL		CLAY; with sand, brown, oxide stains, stiff, slightly damp	
			CS		16				
5			CS		16			...grading to SANDY CLAY; light brown, oxide stains	
			CS		9	SC		CLAYEY SAND; brown, loose, damp	
10			CS		46	SP-SC		SAND; with clay, brown, oxide stains, dense	
15			CS		18	CL		SANDY CLAY; brown, oxide stains, stiff, damp	
20			CS		69	GP-GC		SANDY GRAVEL; with clay, brown and white, very dense, damp	
25			CS		50-5"			BORING TERMINATED AT 26.5 FEET	
30									

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PLATE NO. A-20

Project: Life Time Athletic Country Club **Project Location:** Herriman, UT **Project Number:** 61-224216-0	**BORING NO. B-17**	Western Technologies An RMA Company

Date Logged **01/22/25**	Logged By **Michelle Humberg**	Checked By **Warren Clyde**
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type **7 inch/Hollow Stem Auger**	Total Depth **26.5 feet bgs**
Drill Rig Type **Mobile B-80**	Drilling Contractor **EARTHCORE**	
Groundwater **Groundwater Not Encountered**	Sampling Method(s) **SPT**	
Bore Hole Backfill **Drill Cuttings**	Location **See Boring Location Diagram**	

DEPTH (FEET)	SAMPLE TYPE	SAMPLE	BLOW COUNTS	USCS	SOIL DESCRIPTION	REMARKS AND OTHER TESTS
0				TOPSOIL	TOPSOIL; clay with sand, brown, damp, organics in the top 6 inches	
				CL		Not Sampled
5	N		8		CLAY; brown, firm, slightly damp	
	N		5		...brown and white, damp	
10	N		38	GP-GC	SANDY GRAVEL; with clay, brown and white, dense, damp	
15	N		50		...slightly damp	
20	N		26	GP	GRAVEL; with sand, brown and white and black, medium dense	
25	N		64	GP-GC	GRAVEL; with sand and clay, brown and white, very dense, damp	
					BORING TERMINATED AT 26.5 FEET	
30						

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PLATE NO. A-21

Project: Life Time Athletic Country Club **Project Location:** Herriman, UT **Project Number:** 61-224216-0	**BORING NO. B-18**	Western Technologies An RMA Company

Date Logged **01/22/25**	Logged By **Michelle Humberg**	Checked By **Warren Clyde**
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type **7 inch/Hollow Stem Auger**	Total Depth **26.5 feet bgs**
Drill Rig Type **Mobile B-80**	Drilling Contractor **EARTHCORE**	
Groundwater **Groundwater Not Encountered**	Sampling Method(s) **Modified California**	
Bore Hole Backfill **Drill Cuttings**	Location **See Boring Location Diagram**	

DEPTH (FEET)	MOISTURE CONTENT	DRY DENSITY (LBS/CU FT)	SAMPLE TYPE	SAMPLE	BLOW COUNTS	USCS	GRAPHIC	SOIL DESCRIPTION	REMARKS AND OTHER TESTS
0						TOPSOIL		TOPSOIL; clay with sand, brown, damp, organics in the top 6 inches	
						CL			
	23.0	86.4	CS		15			CLAY; some sand, trace gravel, brown and white streaks, stiff, slightly damp	
5						ML		SILT; some sand, trace gravel, brown, stiff, slightly damp	
	22.9	69.6	CS		17				
						CL		CLAY; some sand, brown, oxide stains, stiff, damp	
	22.8	79.8	CS		13				
10						CH		FAT CLAY; trace sand and gravel, brown, oxide stains, stiff, damp	
	35.3	59.9	CS		15				
15						GP		GRAVEL; with sand, trace silt, brown and light gray, dense, damp	
	2.6		CS		43				
20						GP-GC		GRAVEL; with clay, brown and white, medium dense, slightly damp	
			CS		27				
25						GP-GM		GRAVEL; with sand and silt, brown and gray, medium dense, damp	
	5.9		CS		24			BORING TERMINATED AT 26.5 FEET	
30									

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PLATE NO. A-22

Project: Life Time Athletic Country Club **Project Location:** Herriman, UT **Project Number:** 61-224216-0	**BORING NO. B-19**	Western Technologies An RMA Company

Date Logged **01/22/25**	Logged By **Michelle Humberg**	Checked By **Warren Clyde**
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type **7 inch/Hollow Stem Auger**	Total Depth **26.5 feet bgs**
Drill Rig Type **Mobile B-80**	Drilling Contractor **EARTHCORE**	
Groundwater **Groundwater Not Encountered**	Sampling Method(s) **SPT**	
Bore Hole Backfill **Drill Cuttings**	Location **See Boring Location Diagram**	

DEPTH (FEET)	MOISTURE CONTENT	DRY DENSITY (LBS/CU FT)	SAMPLE TYPE	SAMPLE	BLOW COUNTS	USCS	GRAPHIC	SOIL DESCRIPTION	REMARKS AND OTHER TESTS
0						TOPSOIL		TOPSOIL; clay with sand, brown, damp, organics in the top 6 inches	
						SM			
			N		8			SILTY SAND; light brown, loose, slightly damp	
5						SP-SC			
			N		14			SAND; with clay, brown, medium dense, slightly damp	
						CL			
			N		17			CLAY; brown, oxide stains, very stiff, damp	
10									
			N		14			...with sand, stiff	
15									
			N		14			...grading to SANDY CLAY;	
20						GC			
			N		21			CLAYEY SANDY GRAVEL; brown and white, medium dense, damp	
25						GP-GC			
			N		22			GRAVEL; with sand and clay, white and brown, medium dense, damp	
								BORING TERMINATED AT 26.5 FEET	
30									

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PLATE NO. A-23

Project: Life Time Athletic Country Club **Project Location:** Herriman, UT **Project Number:** 61-224216-0	**BORING NO. B-20**	Western Technologies An RMA Company

Date Logged **01/22/25**	Logged By **Michelle Humberg**	Checked By **Warren Clyde**
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type **7 inch/Hollow Stem Auger**	Total Depth **26.5 feet bgs**
Drill Rig Type **Mobile B-80**	Drilling Contractor **EARTHCORE**	
Groundwater **Groundwater Not Encountered**	Sampling Method(s) **SPT**	
Bore Hole Backfill **Drill Cuttings**	Location **See Boring Location Diagram**	

DEPTH (FEET)	MOISTURE CONTENT	DRY DENSITY (LBS/CU FT)	SAMPLE TYPE	SAMPLE	BLOW COUNTS	USCS	GRAPHIC	SOIL DESCRIPTION	REMARKS AND OTHER TESTS
0			N		12	TOPSOIL		TOPSOIL; clay, brown, stiff, slightly damp, organics	
	22.5		N		8	ML		SILT; some sand, trace gravel, brown with white streaks, firm, slightly damp	
5	23.3		N		11	CL		CLAY; some sand, brown, stiff, slightly damp	
	36.2		N		42	GC		CLAYEY GRAVEL; with sand, brown and white, dense, damp	
10	6.5		N		44	GM		SILTY SANDY GRAVEL; white and brown, dense, damp	
15	13.1		N		9	ML		SILT; with sand, brown, stiff, damp	
20	4.2		N		46	GM		SILTY SANDY GRAVEL; brown and white, dense, damp	
25			N		44			...brown	
								BORING TERMINATED AT 26.5 FEET	
30									

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PLATE NO. A-24

Project: Life Time Athletic Country Club **Project Location:** Herriman, UT **Project Number:** 61-224216-0	**BORING NO. B-21**	Western Technologies An RMA Company

Date Logged **01/23/25**	Logged By **Michelle Humberg**	Checked By **Warren Clyde**
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type **7 inch/Hollow Stem Auger**	Total Depth **26.5 feet bgs**
Drill Rig Type **Mobile B-80**	Drilling Contractor **EARTHCORE**	
Groundwater **Groundwater Not Encountered**	Sampling Method(s) **Modified California**	
Bore Hole Backfill **Drill Cuttings**	Location **See Boring Location Diagram**	

DEPTH (FEET)	MOISTURE CONTENT	DRY DENSITY (LBS/CU FT)	SAMPLE TYPE	SAMPLE	BLOW COUNTS	USCS	GRAPHIC	SOIL DESCRIPTION	REMARKS AND OTHER TESTS
0						TOPSOIL		TOPSOIL; clay with sand, brown, damp, organics in the top 6 inches	
						ML			
	21.4	66.9	CS		15			SILT; some sand, brown with white streaks, stiff, slightly damp	
5	19.6	78.4	CS		22			...some sand, trace gravel, brown, oxide stains, very stiff	
	46.2	54.5	CS		14	MH		ELASTIC SILT; trace sand, brown, stiff, damp	
10	9.0	96.0	CS		21	CL		CLAY; some sand, brown, oxide stains, very stiff, damp	
15	16.1		CS		33			...some sand and gravel, brown and white and black	
20	18.5	107.1	CS		12			&some sand, trace gravel, brown, stiff	
25	6.5	109.0	CS		49	GM		SILTY SANDY GRAVEL; brown, dense, damp	
								BORING TERMINATED AT 26.5 FEET	
30									

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PLATE NO. A-25

Project: Life Time Athletic Country Club **Project Location:** Herriman, UT **Project Number:** 61-224216-0	**BORING NO. B-22**	Western Technologies An RMA Company

Date Logged **01/23/25**	Logged By **Michelle Humberg**	Checked By **Warren Clyde**
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type **7 inch/Hollow Stem Auger**	Total Depth **19 feet bgs**
Drill Rig Type **Mobile B-80**	Drilling Contractor **EARTHCORE**	
Groundwater **Groundwater Not Encountered**	Sampling Method(s) **Modified California**	
Bore Hole Backfill **Drill Cuttings**	Location **See Boring Location Diagram**	

DEPTH (FEET)	MOISTURE CONTENT	DRY DENSITY (LBS/CU FT)	SAMPLE TYPE	SAMPLE	BLOW COUNTS	USCS	GRAPHIC	SOIL DESCRIPTION	REMARKS AND OTHER TESTS
0						TOPSOIL		TOPSOIL; clay with sand, brown, damp, organics in the top 6 inches	
						ML			
	21.9	82.2	CS		13			SANDY SILT; brown and white, oxide stains, stiff, slightly damp	
5	17.7	93.7	CS		23			...grading to SILT; some sand, very stiff	
	49.4	56.1	CS		13	MH		ELASTIC SILT; some sand, brown and black, oxide stains, stiff, damp	
10	14.2	95.7	CS		24	CL		SANDY CLAY; some gravel, brown and white, oxide stains, very stiff, damp	
15	10.6		CS		21	ML		SANDY SILT; trace gravel, brown, very stiff, damp	
								AUGER REFUSAL AT 19 FEET	
20									
25									
30									

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PLATE NO. A-26

Project: Life Time Athletic Country Club **Project Location:** Herriman, UT **Project Number:** 61-224216-0	**BORING NO. B-23**	Western Technologies An RMA Company

Date Logged **01/23/25**	Logged By **Michelle Humberg**	Checked By **Warren Clyde**
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type **7 inch/Hollow Stem Auger**	Total Depth **26.5 feet bgs**
Drill Rig Type **Mobile B-80**	Drilling Contractor **EARTHCORE**	
Groundwater **Groundwater Not Encountered**	Sampling Method(s) **SPT**	
Bore Hole Backfill **Drill Cuttings**	Location **See Boring Location Diagram**	

DEPTH (FEET)	MOISTURE CONTENT	DRY DENSITY (LBS/CU FT)	SAMPLE TYPE	SAMPLE	BLOW COUNTS	USCS	GRAPHIC	SOIL DESCRIPTION	REMARKS AND OTHER TESTS
0						TOPSOIL		TOPSOIL; clay with sand, brown, damp, organics in the top 6 inches	
						CL			
			N		9			CLAY; brown, oxide stains, stiff, slightly damp	
5			N		9			...brown and white, oxide stains	
			N		16			...grading to SANDY CLAY; brown, very stiff	
10			N		10			...grading to CLAY; with sand, brown, oxide stains, stiff, damp	
15			N		16			...grading to SANDY CLAY; brown, very stiff	
20			N		7			...grading to CLAY; with sand, some gravel, firm	
25			N		38	GP		GRAVEL; with sand, light brown and white, dense, slightly damp	
								BORING TERMINATED AT 26.5 FEET	
30									

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PLATE NO. A-27

Project: Life Time Athletic Country Club **Project Location:** Herriman, UT **Project Number:** 61-224216-0	**BORING NO. B-24**	Western Technologies An RMA Company

Date Logged **01/23/25**	Logged By **Michelle Humberg**	Checked By **Warren Clyde**
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type **7 inch/Hollow Stem Auger**	Total Depth **21.5 feet bgs**
Drill Rig Type **Mobile B-80**	Drilling Contractor **EARTHCORE**	
Groundwater **Groundwater Not Encountered**	Sampling Method(s) **SPT**	
Bore Hole Backfill **Drill Cuttings**	Location **See Boring Location Diagram**	

DEPTH (FEET)	MOISTURE CONTENT	DRY DENSITY (LBS/CU FT)	SAMPLE TYPE	SAMPLE	BLOW COUNTS	USCS	GRAPHIC	SOIL DESCRIPTION	REMARKS AND OTHER TESTS
0						TOPSOIL		TOPSOIL; clay with sand, brown, damp, organics in the top 6 inches	Drilled down 10' to sample at similar elevation to other borings in project
						CL		GRAVELLY CLAY; brown	
5									
10									
			N		12			...grading to CLAY; brown with white streaks, stiff, slightly damp	
15			N		12			...with sand, brown and white	
			N		17	SP-SC		CLAYEY SAND; brown, medium dense, slightly damp	
20			N		58	GP		GRAVEL; with sand and clay; brown and white, very dense, damp	
								BORING TERMINATED AT 21.5 FEET	
25									
30									

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PLATE NO. A-28

Project: Life Time Athletic Country Club **Project Location:** Herriman, UT **Project Number:** 61-224216-0	**BORING NO. B-25**	Western Technologies An RMA Company

Date Logged **01/23/25**	Logged By **Michelle Humberg**	Checked By **Warren Clyde**
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type **7 inch/Hollow Stem Auger**	Total Depth **11.5 feet bgs**
Drill Rig Type **Mobile B-80**	Drilling Contractor **EARTHCORE**	
Groundwater **Groundwater Not Encountered**	Sampling Method(s) **Modified California**	
Bore Hole Backfill **Drill Cuttings**	Location **See Boring Location Diagram**	

DEPTH (FEET)	MOISTURE CONTENT	DRY DENSITY (LBS/CU FT)	SAMPLE TYPE	SAMPLE	BLOW COUNTS	USCS	GRAPHIC	SOIL DESCRIPTION	REMARKS AND OTHER TESTS
0						TOPSOIL		TOPSOIL; clay with sand, brown, damp, organics in the top 6 inches	
						CL			
	27.4	52.0	CS		14			CLAY; trace sand, brown with white streaks, stiff, slightly damp	
5						MH			
	3.7	77.0	CS		12			ELASTIC SILT; trace sand, brown, oxide stains, stiff, slightly damp	
						CL			
	15.2		CS		15			CLAY; with sand, trace gravel, brown, stiff, slightly damp	
10									
			CS		38			...grading to SANDY CLAY; with gravel, brown, oxide stains, very stiff	
								BORING TERMINATED AT 11.5 FEET	
15									
20									
25									
30									

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PLATE NO. A-29

Project: LIFE TIME ATHLETIC COUNTRY CLUB
Project Location: HERRIMAN
Project Number: 61-224216-0

BORING NO. AB-1

Western Technologies
An RMA Company

Date Logged **05/08/25**	Logged By **Michelle Humberg**	Checked By **Warren Clyde**
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type **7 inch/Hollow Stem Auger**	Total Depth **11.5 feet bgs**
Drill Rig Type **Mobile B-80**	Drilling Contractor **EARTHCORE**	
Groundwater **Groundwater Not Encountered**	Sampling Method(s) **California**	
Bore Hole Backfill **Drill Cuttings**	Location **See Boring Location Diagram**	

DEPTH (FEET)	MOISTURE CONTENT	DRY DENSITY (LBS/CU FT)	SAMPLE TYPE	SAMPLE	BLOW COUNTS	USCS	GRAPHIC	SOIL DESCRIPTION	REMARKS AND OTHER TESTS
0						TOPSOIL		TOPSOIL; clay with sand, brown, slightly damp, organics in the top 6 inches	
						CL		CLAY; brown and white, stiff, slightly damp	
	28.7	75.8	C		16				
5								...grading to SANDY CLAY; brown, pinholes	
	23.4	72.5	C		15				
								...oxide stains	
	60.5	52.7	C		17				
10								...grading to CLAY; damp	
	49.2	64.3	C		18				
								BORING TERMINATED AT 11.5 FEET	
15									

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PLATE NO. A-30

Project: LIFE TIME ATHLETIC COUNTRY CLUB **Project Location:** HERRIMAN **Project Number:** 61-224216-0	**BORING NO. AB-2**	Western Technologies An RMA Company

Date Logged **05/08/25**	Logged By **Michelle Humberg**	Checked By **Warren Clyde**
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type **7 inch/Hollow Stem Auger**	Total Depth **11.5 feet bgs**
Drill Rig Type **Mobile B-80**	Drilling Contractor **EARTHCORE**	
Groundwater **Groundwater Not Encountered**	Sampling Method(s) **California**	
Bore Hole Backfill **Drill Cuttings**	Location **See Boring Location Diagram**	

DEPTH (FEET)	MOISTURE CONTENT	DRY DENSITY (LBS/CU FT)	SAMPLE TYPE	SAMPLE	BLOW COUNTS	USCS	GRAPHIC	SOIL DESCRIPTION	REMARKS AND OTHER TESTS
0						TOPSOIL		TOPSOIL; clay with sand, brown, slightly damp, organics in the top 6 inches	
						CL		CLAY; brown and white, stiff, slightly damp	
	26.0	70.7	C		15				
5								...grading to SANDY CLAY; brown, oxide stains	
	24.0	61.7	C		17				
								...very stiff, pinholes	
	59.8	56.0	C		26				
10								...light brown, oxide stains	
	48.5	55.6	C		22				
								BORING TERMINATED AT 11.5 FEET	
15									

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PLATE NO. A-31

Project: LIFE TIME ATHLETIC COUNTRY CLUB **Project Location:** HERRIMAN **Project Number:** 61-224216-0	**BORING NO. AB-3**	Western Technologies An RMA Company

Date Logged **05/08/25**	Logged By **Michelle Humberg**	Checked By **Warren Clyde**
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type **7 inch/Hollow Stem Auger**	Total Depth **11.5 feet bgs**
Drill Rig Type **Mobile B-80**	Drilling Contractor **EARTHCORE**	
Groundwater **Groundwater Not Encountered**	Sampling Method(s) **California**	
Bore Hole Backfill **Drill Cuttings**	Location **See Boring Location Diagram**	

DEPTH (FEET)	MOISTURE CONTENT	DRY DENSITY (LBS/CU FT)	SAMPLE TYPE	SAMPLE	BLOW COUNTS	USCS	GRAPHIC	SOIL DESCRIPTION	REMARKS AND OTHER TESTS
0						TOPSOIL		TOPSOIL; clay with sand, brown, slightly damp, organics in the top 6 inches	
						CL		CLAY; light brown, oxide stains, very stiff, slightly damp, pinholes	
	30.3	66.6	C		22				
5	27.9	70.5	C		24				
	45.0	63.6	C		23			...brown, damp	
10	47.8	67.3	C		32			...grading to SANDY CLAY; oxide stains	
								BORING TERMINATED AT 11.5 FEET	
15									

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PLATE NO. A-32

Project: LIFE TIME ATHLETIC COUNTRY CLUB **Project Location:** HERRIMAN **Project Number:** 61-224216-0	**BORING NO. AB-4**	Western Technologies An RMA Company

Date Logged **05/08/25**	Logged By **Michelle Humberg**	Checked By **Warren Clyde**
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type **7 inch/Hollow Stem Auger**	Total Depth **11.5 feet bgs**
Drill Rig Type **Mobile B-80**	Drilling Contractor **EARTHCORE**	
Groundwater **Groundwater Not Encountered**	Sampling Method(s) **California**	
Bore Hole Backfill **Drill Cuttings**	Location **See Boring Location Diagram**	

DEPTH (FEET)	MOISTURE CONTENT	DRY DENSITY (LBS/CU FT)	SAMPLE TYPE	SAMPLE	BLOW COUNTS	USCS	GRAPHIC	SOIL DESCRIPTION	REMARKS AND OTHER TESTS
0						TOPSOIL		TOPSOIL; clay with sand, brown, slightly damp, organics in the top 6 inches	
						CL		CLAY; light brown, oxide stains, stiff, slightly damp	
	29.2	79.4	C		19				
5								...brown	
	28.0	84.3	C		21				
								...damp	
	52.2	64.0	C		16				
10						SP-SC		GRAVELLY SAND; with clay, brown and orange, very dense, slightly damp	
			C		83				
								BORING TERMINATED AT 11.5 FEET	
15									

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PLATE NO. A-33

Project: LIFE TIME ATHLETIC COUNTRY CLUB **Project Location:** HERRIMAN **Project Number:** 61-224216-0	**BORING NO. AB-5**	Western Technologies An RMA Company

Date Logged **05/08/25**	Logged By **Michelle Humberg**	Checked By **Warren Clyde**
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type **7 inch/Hollow Stem Auger**	Total Depth **11.5 feet bgs**
Drill Rig Type **Mobile B-80**	Drilling Contractor **EARTHCORE**	
Groundwater **Groundwater Not Encountered**	Sampling Method(s) **California**	
Bore Hole Backfill **Drill Cuttings**	Location **See Boring Location Diagram**	

DEPTH (FEET)	MOISTURE CONTENT	DRY DENSITY (LBS/CU FT)	SAMPLE TYPE	SAMPLE	BLOW COUNTS	USCS	GRAPHIC	SOIL DESCRIPTION	REMARKS AND OTHER TESTS
0						TOPSOIL		TOPSOIL; clay with sand, brown, slightly damp, organics in the top 6 inches	
						CL		CLAY; brown and white, very stiff, damp	
	29.0	75.9	C		23				
5								...grading to SANDY CLAY; light brown, oxide stains	
	25.5	78.9	C		24				
								...brown	
	54.9	62.5	C		32				
10						SC		CLAYEY SAND; brown, dense, damp	
			C		53				
								BORING TERMINATED AT 11.5 FEET	
15									

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PLATE NO. A-34

Project: LIFE TIME ATHLETIC COUNTRY CLUB
Project Location: HERRIMAN
Project Number: 61-224216-0

BORING NO. AB-6

Western Technologies
An RMA Company

Date Logged **05/08/25**	Logged By **Michelle Humberg**	Checked By **Warren Clyde**
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type **7 inch/Hollow Stem Auger**	Total Depth **11.5 feet bgs**
Drill Rig Type **Mobile B-80**	Drilling Contractor **EARTHCORE**	
Groundwater **Groundwater Not Encountered**	Sampling Method(s) **California**	
Bore Hole Backfill **Drill Cuttings**	Location **See Boring Location Diagram**	

DEPTH (FEET)	MOISTURE CONTENT	DRY DENSITY (LBS/CU FT)	SAMPLE TYPE	SAMPLE	BLOW COUNTS	USCS	GRAPHIC	SOIL DESCRIPTION	REMARKS AND OTHER TESTS
0						TOPSOIL		TOPSOIL; clay with sand, brown, slightly damp, organics in the top 6 inches	
						CL		CLAY; brown and white, very stiff, slightly damp	
	29.6	80.4	C		20				
5								...light brown, oxide stains	
	22.9	74.4	C		24				
								...brown, stiff, damp	
	49.9	58.7	C		14				
10								...hard	
			C		46				
								BORING TERMINATED AT 11.5 FEET	
15									

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PLATE NO. A-35

Project: LIFE TIME ATHLETIC COUNTRY CLUB **Project Location:** HERRIMAN **Project Number:** 61-224216-0	**BORING NO. AB-7**	Western Technologies An RMA Company

Date Logged **05/08/25**	Logged By **Michelle Humberg**	Checked By **Warren Clyde**
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type **7 inch/Hollow Stem Auger**	Total Depth **11.5 feet bgs**
Drill Rig Type **Mobile B-80**	Drilling Contractor **EARTHCORE**	
Groundwater **Groundwater Not Encountered**	Sampling Method(s) **California**	
Bore Hole Backfill **Drill Cuttings**	Location **See Boring Location Diagram**	

DEPTH (FEET)	SAMPLE TYPE	SAMPLE	BLOW COUNTS	USCS	SOIL DESCRIPTION	REMARKS AND OTHER TESTS
0				TOPSOIL	TOPSOIL; clay with sand, brown, slightly damp, organics in the top 6 inches	
				CL	GRAVELLY CLAY; brown, very stiff, slightly damp	
	C		29			
5					...grading to SANDY CLAY; light brown, oxide stains	
	C		21			
				SP-SC	SAND; with clay and gravel, brown, medium dense, slightly damp	
	C		20			
10				SC	CLAYEY SAND; brown, medium dense, slightly damp	
	C		23			
					BORING TERMINATED AT 11.5 FEET	
15						

MOISTURE CONTENT

DRY DENSITY (LBS/CU FT)

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PLATE NO. A-36

Project: LIFE TIME ATHLETIC COUNTRY CLUB **Project Location:** HERRIMAN **Project Number:** 61-224216-0	**BORING NO. AB-8**	Western Technologies An RMA Company

Date Logged **05/08/25**	Logged By **Michelle Humberg**	Checked By **Warren Clyde**
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type **7 inch/Hollow Stem Auger**	Total Depth **11.5 feet bgs**
Drill Rig Type **Mobile B-80**	Drilling Contractor **EARTHCORE**	
Groundwater **Groundwater Not Encountered**	Sampling Method(s) **California**	
Bore Hole Backfill **Drill Cuttings**	Location **See Boring Location Diagram**	

DEPTH (FEET)	MOISTURE CONTENT	DRY DENSITY (LBS/CU FT)	SAMPLE TYPE	SAMPLE	BLOW COUNTS	USCS	GRAPHIC	SOIL DESCRIPTION	REMARKS AND OTHER TESTS
0						TOPSOIL		TOPSOIL; clay with sand, slightly damp, organics in the top 6 inches	
						CL		CLAY; light brown, oxide stains, stiff, slightly damp	
	29.3	67.3	C		17				
5								...grading to SANDY CLAY; brown, firm	
	32.4	69.9	C		10				
								...light brown, hard, damp	
	63.2	36.7	C		44				
10						GC		CLAYEY GRAVEL; with sand, brown, very dense, damp	
			C		50-4"				
								BORING TERMINATED AT 11.5 FEET	
15									

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PLATE NO. A-37

Project: LIFE TIME ATHLETIC COUNTRY CLUB **Project Location:** HERRIMAN **Project Number:** 61-224216-0	**BORING NO. AB-9**	Western Technologies An RMA Company

Date Logged **05/08/25**	Logged By **Michelle Humberg**	Checked By **Warren Clyde**
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type **7 inch/Hollow Stem Auger**	Total Depth **11.5 feet bgs**
Drill Rig Type **Mobile B-80**	Drilling Contractor **EARTHCORE**	
Groundwater **Groundwater Not Encountered**	Sampling Method(s) **California**	
Bore Hole Backfill **Drill Cuttings**	Location **See Boring Location Diagram**	

DEPTH (FEET)	MOISTURE CONTENT	DRY DENSITY (LBS/CU FT)	SAMPLE TYPE	SAMPLE	BLOW COUNTS	USCS	GRAPHIC	SOIL DESCRIPTION	REMARKS AND OTHER TESTS
0						TOPSOIL		TOPSOIL; clay with sand, brown, slightly damp, organics in the top 6 inches	
						CL		CLAY; brown and white, stiff, slightly damp	
	23.5	66.5	C		15				
5								...light brown, oxide stains, very stiff	
	18.7	70.0	C		23				
								...brown, hard, damp	
	50.7	57.9	C		47				
10						SC		CLAYEY SAND; with gravel, brown, oxide stains, medium dense, damp	
			C		32				
								BORING TERMINATED AT 11.5 FFET	
15									

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PLATE NO. A-38

Project: LIFE TIME ATHLETIC COUNTRY CLUB
Project Location: HERRIMAN
Project Number: 61-224216-0

BORING NO. AB-10

Western Technologies
An RMA Company

Date Logged **05/08/25**	Logged By **Michelle Humberg**	Checked By **Warren Clyde**
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type **7 inch/Hollow Stem Auger**	Total Depth **11.5 feet bgs**
Drill Rig Type **Mobile B-80**	Drilling Contractor **EARTHCORE**	
Groundwater **Groundwater Not Encountered**	Sampling Method(s) **California**	
Bore Hole Backfill **Drill Cuttings**	Location **See Boring Location Diagram**	

DEPTH (FEET)	MOISTURE CONTENT	DRY DENSITY (LBS/CU FT)	SAMPLE TYPE	SAMPLE	BLOW COUNTS	USCS	GRAPHIC	SOIL DESCRIPTION	REMARKS AND OTHER TESTS
0						TOPSOIL		TOPSOIL; clay with sand, brown, slightly damp, organics in the top 6 inches	
						CL		CLAY; light brown, oxide stains, stiff, slightly damp	
	23.2	73.3	C		17				
5								...very stiff	
	25.2	70.2	C		24				
								...brown,	
	23.7	92.2	C		25				
10									
			C		24				
								BORING TERMINATED AT 11.5 FEET	
15									

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PLATE NO. A-39

Project: LIFE TIME ATHLETIC COUNTRY CLUB **Project Location:** HERRIMAN **Project Number:** 61-224216-0	**BORING NO. AB-11**	Western Technologies An RMA Company

Date Logged **05/08/25**	Logged By **Michelle Humberg**	Checked By **Warren Clyde**
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type **7 inch/Hollow Stem Auger**	Total Depth **11.5 feet bgs**
Drill Rig Type **Mobile B-80**	Drilling Contractor **EARTHCORE**	
Groundwater **Groundwater Not Encountered**	Sampling Method(s) **Modified California**	
Bore Hole Backfill **Drill Cuttings**	Location **See Boring Location Diagram**	

DEPTH (FEET)	MOISTURE CONTENT	DRY DENSITY (LBS/CU FT)	SAMPLE TYPE	SAMPLE	BLOW COUNTS	USCS	GRAPHIC	SOIL DESCRIPTION	REMARKS AND OTHER TESTS
0						TOPSOIL		TOPSOIL; clay with sand, brown, slightly damp, organics in the top 6 inches	
						CL		CLAY; brown and white, very stiff, slightly damp	
			CS		24				
5								...brown, oxide stains	
			CS		26				
								...grading to SANDY CLAY	
	48.4	60.0	CS		30				
10								...damp	
	38.4	72.1	CS		24				
								BORING TERMINATED AT 11.5 FEET	
15									

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PLATE NO. A-40

Project: LIFE TIME ATHLETIC COUNTRY CLUB
Project Location: HERRIMAN
Project Number: 61-224216-0

BORING NO. AB-12

Western Technologies
An RMA Company

Date Logged **05/08/25**	Logged By **Michelle Humberg**	Checked By **Warren Clyde**
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type **7 inch/Hollow Stem Auger**	Total Depth **11.5 feet bgs**
Drill Rig Type **Mobile B-80**	Drilling Contractor **EARTHCORE**	
Groundwater **Groundwater Not Encountered**	Sampling Method(s) **Modified California**	
Bore Hole Backfill **Drill Cuttings**	Location **See Boring Location Diagram**	

DEPTH (FEET)	MOISTURE CONTENT	DRY DENSITY (LBS/CU FT)	SAMPLE TYPE	SAMPLE	BLOW COUNTS	USCS	GRAPHIC	SOIL DESCRIPTION	REMARKS AND OTHER TESTS
0						TOPSOIL		TOPSOIL; clay with sand, brown, slightly damp, organics in the top 6 inches	
						CL		SANDY CLAY; light brown, stiff, slightly damp, organics	
	13.4	70.3	CS		15				
5									
	14.1	64.1	CS		19				
								...light brown, oxide stains, very stiff	
	35.4	71.1	CS		31				
10						SC		CLAYEY SAND; light brown, oxide stains, medium dense, slightly damp	
	34.1	63.9	CS		25				
								BORING TERMINATED AT 11.5 FEET	
15									

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PLATE NO. A-41

Project: LIFE TIME ATHLETIC COUNTRY CLUB **Project Location:** HERRIMAN **Project Number:** 61-224216-0	**BORING NO. AB-13**	Western Technologies An RMA Company

Date Logged **05/08/25**	Logged By **Michelle Humberg**	Checked By **Warren Clyde**
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type **7 inch/Hollow Stem Auger**	Total Depth **11.5 feet bgs**
Drill Rig Type **Mobile B-80**	Drilling Contractor **EARTHCORE**	
Groundwater **Groundwater Not Encountered**	Sampling Method(s) **Modified California**	
Bore Hole Backfill **Drill Cuttings**	Location **See Boring Location Diagram**	

DEPTH (FEET)	MOISTURE CONTENT	DRY DENSITY (LBS/CU FT)	SAMPLE TYPE	SAMPLE	BLOW COUNTS	USCS	GRAPHIC	SOIL DESCRIPTION	REMARKS AND OTHER TESTS
0						TOPSOIL		TOPSOIL; clay with sand, brown, slightly damp, organics in the top 6 inches	
						CL		CLAY; light brown and white, stiff, slightly damp, organics	
	9.15	72.9	CS		16				
5								...grading to SANDY CLAY; light brown, very stiff	
	20.7	71.1	CS		26				
								...light brown, oxide stains, stiff	
	39.1	50.5	CS		16				
10						SM		SILTY SAND; light brown, dense, slightly damp	
	31.4	72.6	CS		44				
								BORING TERMIINATED AT 11.5 FEET	
15									

G:\2025\61-224216-0-LIFE TIM-LIFE TIME ATHLE\DOCUMENTS\SECOND SET OF BORINGS\LOGS\BORING LOGS.bg4[WT-SLC.tpl]

PLATE NO. A-42

Project: LIFE TIME ATHLETIC COUNTRY CLUB **Project Location:** HERRIMAN **Project Number:** 61-224216-0	**BORING NO. AB-14**	Western Technologies An RMA Company

Date Logged **05/08/25**	Logged By **Michelle Humberg**	Checked By **Warren Clyde**
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type **7 inch/Hollow Stem Auger**	Total Depth **11.5 feet bgs**
Drill Rig Type **Mobile B-80**	Drilling Contractor **EARTHCORE**	
Groundwater **Groundwater Not Encountered**	Sampling Method(s) **Modified California**	
Bore Hole Backfill **Drill Cuttings**	Location **See Boring Location Diagram**	

DEPTH (FEET)	MOISTURE CONTENT	DRY DENSITY (LBS/CU FT)	SAMPLE TYPE	SAMPLE	BLOW COUNTS	USCS	GRAPHIC	SOIL DESCRIPTION	REMARKS AND OTHER TESTS
0						TOPSOIL		TOPSOIL; clay with sand, brown, slightly damp, organics in the top 6 inches	
						CL		CLAY; brown and white, stiff, slightly damp	
	17.6	58.9	CS		14				
5								...brown, oxide stains	
	26.3	63.9	CS		16				
								...light brown	
	43.1	65.1	CS		20				
10						SM		SILTY SAND; with gravel, brown, oxide stains, medium dense, slightly damp	
			CS		26				
								BORING TERMINATED AT 11.5 FEET	
15									

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PLATE NO. A-43

Project: LIFE TIME ATHLETIC COUNTRY CLUB **Project Location:** HERRIMAN **Project Number:** 61-224216-0	**BORING NO. AB-15**	Western Technologies An RMA Company

Date Logged **05/08/25**	Logged By **Michelle Humberg**	Checked By **Warren Clyde**
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type **7 inch/Hollow Stem Auger**	Total Depth **11.5 feet bgs**
Drill Rig Type **Mobile B-80**	Drilling Contractor **EARTHCORE**	
Groundwater **Groundwater Not Encountered**	Sampling Method(s) **Modified California**	
Bore Hole Backfill **Drill Cuttings**	Location **See Boring Location Diagram**	

DEPTH (FEET)	MOISTURE CONTENT	DRY DENSITY (LBS/CU FT)	SAMPLE TYPE	SAMPLE	BLOW COUNTS	USCS	GRAPHIC	SOIL DESCRIPTION	REMARKS AND OTHER TESTS
0						TOPSOIL		TOPSOIL; clay with sand, brown, slightly damp, organics in the top 6 inches	
						CL		CLAY; light brown, oxide stains, stiff, slightly damp, pinholes, organics	
	20.2	74.5	CS		17				
5								...brown	
	24.3	89.6	CS		15				
								...grading to SANDY CLAY; very stiff, damp	
			CS		30				
10						SC		CLAYEY SAND; brown, medium dense, damp	
			CS		19				
								BORING TERMINATED AT 11.5 FEET	
15									

G:\2025\61-224216-0-LIFE TIM-LIFE TIME ATHLE\DOCUMENTS\SECOND SET OF BORINGS\LOGS\BORING LOGS.bg4[WT-SLC.tpl]

PLATE NO. A-44

APPENDIX B

Boring No.	Sample Depth (ft)	USCS Class.	Initial Dry Density (pcf)	Initial Water Content (%)	Percent Passing		Atterberg Limits		Collapse/Compression Properties			Remarks
					#4	#200	LL	PI	Surcharge (ksf)	Total Compression (%)		
										In-Situ	After Saturation	
B-1	2.5	CL	--	16.0	100	89	35	16				
	5	CH	--	27.9	100	98	54	26				
B-3	2.5	ML	--	30.1	100	91	41	11				
	5	ML	--	28.8	99	90	36	11				
B-4	2.5	ML	--	25.4	100	90	40	11				
	5	ML	--	21.3	99	90	36	11				
	7.5	MH	--	49.3	99	93	63	27				
B-5	2.5	ML	--	11.6	100	91	40	11				
	5	ML	--	13.4	100	91	35	8				
B-6	2.5	ML	--	29.5	98	89	45	14				
	5	ML	--	26.8	100	89	41	14				
B-7	2.5	ML	--	18.8	100	91	40	11				
	5	ML	--	19.7	98	87	38	11				
B-9	2.5	CL	--	12.8	100	97	41	20				
	5	GM	--	5.2	35	21	--	NP				
B-10	2.5	CL	--	17.8	99	86	37	18				
	5	CH	--	36.6	100	91	52	25				
B-11	2.5	CL	82.6	23.4	100	97	39	17				
	5	CL	--	29.5	76	55	43	19				
B-12	5	CL	82.4	9.5	98	86	36	12	1.6	-2.84	-5.17	1,4
	7.5	CL	99.1	18.6	100	96	40	20	1.7	-1.49	-1.42	1,3
	10	MH	69.3	39.4	100	94	69	31	1.7	-0.48	0.15	1,3
	15	CL	109.1	14.6	100	64	26	10				
	20	GM	--	3.5	49	12	--	NP				
	25	GC	114.0	14.6	63	33	29	14				

NOTES: Initial Dry Density and initial Water Content are in-situ values unless otherwise noted.
NP = Non-plastic

REMARKS – Collapse / Compression

1. Submerged to approximate saturation.
2. Sample disturbance observed.
3. Slight rebound after saturation.
4. Additional compression after saturation.

Western Technologies
An RMA Company

PROJECT: LIFE TIME ATHLETIC COUNTRY CLUB - HERRIMAN
JOB NO.: 61-224216-0

PLATE
B-1

SOIL PROPERTIES

Boring No.	Sample Depth (ft)	USCS Class.	Initial Dry Density (pcf)	Initial Water Content (%)	Percent Passing		Atterberg Limits		Collapse/Compression Properties			Remarks
					#4	#200	LL	PI	Surcharge (ksf)	Total Compression (%)		
										In-Situ	After Saturation	
B-13	2.5	ML	--	24.5	90	80	43	13				
	5	CL	--	23.9	100	92	41	16				
	7.5	CL	--	25.1	100	95	37	17				
	10	CH	--	61.1	100	96	69	36				
	15	CL	--	20.0	100	93	41	23				
	20	SM	--	7.8	68	35	--	NP				
	25	GP-GM	--	4.8	46	11	--	NP				
B-14	2.5	ML	72.8	29.8	98	87	44	15				
	5	ML	80.2	26.6	96	88	39	9				
B-15	2.5	ML	--	29.7	99	87	44	13				
	5	CL	--	28.2	100	88	40	15				
	7.5	CH	--	74.7	100	93	72	39				
	10	SC	--	24.5	64	24	36	15				
	15	GP-GM	--	3.1	47	8	--	NP				
	20	SC	--	9.5	82	38	25	9				
B-18	2.5	CL	86.4	23.0	99	87	39	14	1.7	-1.27	-1.27	1
	5	ML	69.6	22.9	99	87	38	13	1.7	-2.46	-3.31	1,4
	7.5	CL	79.8	22.8	100	95	39	19	1.7	-1.93	-4.75	1,2,4*
	10	CH	59.9	35.3	97	92	60	32	1.7	-3.69	-4.47	1,4
	15	GP	--	2.6	28	3	--	NP				
	25	GP-GM	--	5.9	29	9	--	NP				
B-20	2.5	ML	--	22.5	99	93	40	14				
	5	CL	--	23.3	100	94	36	13				
	7.5	GC	--	36.2	61	38	31	15				
	10	GM	--	6.5	62	25	--	NP				
	15	ML	--	13.1	100	74	--	NP				

NOTES: Initial Dry Density and initial Water Content are in-situ values unless otherwise noted.
NP = Non-plastic

REMARKS – Collapse / Compression

1. Submerged to approximate saturation.
2. Sample disturbance observed. * Gauge hung up during testing so collapse reading is incorrect.
3. Slight rebound after saturation.
4. Additional compression after saturation.

Western Technologies
An RMA Company

PROJECT: LIFE TIME ATHLETIC COUNTRY CLUB - HERRIMAN
JOB NO.: 61-224216-0

SOIL PROPERTIES

PLATE
B-2

Boring No.	Sample Depth (ft)	USCS Class.	Initial Dry Density (pcf)	Initial Water Content (%)	Percent Passing		Atterberg Limits		Collapse/Compression Properties			Remarks
					#4	#200	LL	PI	Surcharge (ksf)	Total Compression (%)		
										In-Situ	After Saturation	
B-20	20	GM	--	4.2	51	12	--	NP				
B-21	2.5	ML	66.9	21.4	100	93	44	16	1.7	-3.40	-5.76	1,4
	5	ML	78.4	19.6	99	92	38	12	1.7	-0.25	-1.23	1,4
	7.5	MH	54.5	46.2	100	98	71	37	1.6	-3.98	-4.78	1,4
	10	CL	96.0	9.0	100	85	46	22	1.6	-2.54	-4.24	1,4
	15	CL	--	16.1	95	80	34	18				
	20	CL	107.1	18.5	99	85	28	13	1.6	-1.38	-1.36	1,3
	25	GM	109.0	6.5	44	13	--	NP				
B-22	2.5	ML	82.2	21.9	100	53	43	11	1.7	-1.04	-1.39	1,4
	5	ML	93.7	17.7	100	90	40	14	1.7	-0.96	-1.11	1,4
	7.5	MH	56.1	49.4	100	90	58	27	1.7	-3.07	-3.02	1,3
	10	CL	95.7	14.2	90	58	33	17	1.7	-0.37	-2.18	1,4
	15	ML	--	10.6	97	56	--	NP				
B-25	2.5	CL	52.0	88.0	100	97	40	19	1.7	-2.52	-2.47	1,3
	5	MH	77.0	52.2	100	97	82	43	1.7	-2.95	-2.87	1,3
	7.5	CL	--	15.2	98	79	32	15				

NOTES: Initial Dry Density and initial Water Content are in-situ values unless otherwise noted.
NP = Non-plastic

REMARKS – Collapse / Compression

1. Submerged to approximate saturation.
2. Sample disturbance observed.
3. Slight rebound after saturation.
4. Additional compression after saturation.

Western Technologies
An RMA Company

PROJECT: LIFE TIME ATHLETIC COUNTRY CLUB
JOB NO.: 61-224216-0

PLATE
B-3

SOIL PROPERTIES

Boring No.	Sample Depth (ft)	USCS Class.	Initial Dry Density (pcf)	Initial Water Content (%)	Percent Passing		Atterberg Limits		Collapse Properties		Remarks
					#4	#200	LL	PI	Surcharge (ksf)	Total Collapse (%)	
AB-1	2.5		75.8	28.7					1.1	-1.06	1,4
	5		72.5	23.4					1.1	-1.48	1,4
	7.5		52.7	60.5					1.1	0.73	1,3
	10		64.3	49.2					1.1	-0.34	1,4
AB-2	2.5		70.7	26.0					1.1	-1.21	1,4
	5		61.7	24.0					1.1	-5.15	1,4
	7.5		56.0	59.8					1.1	0.34	1,3
	10		55.6	48.5					1.1	0.22	1,3
AB-3	2.5		66.6	30.3					1.0	-1.52	1,4
	5		70.5	27.9					1.0	-4.10	1,4
	7.5		63.6	45.0					1.0	-1.87	1,4
	10		67.3	47.8					1.1	-0.98	1,4
AB-4	2.5		79.4	29.2					1.1	-0.94	1,4
	5		84.3	28.0					1.0	-2.41	1,4
	7.5		64.0	52.2					1.1	-2.94	1,4
AB-5	2.5		75.9	29.0					1.0	-2.94	1,4
	5		78.9	25.5					1.1	-1.98	1,4
	7.5		62.5	54.9					1.1	0.01	1,3
AB-6	2.5		80.4	29.6					1.1	-0.70	1,4
	5		74.4	22.9					1.0	-4.02	1,4
	7.5		58.7	49.9					1.1	-1.01	1,4
AB-8	2.5		67.3	29.3					1.0	-3.78	1,4
	5		69.9	32.4					1.0	-5.33	1,4
	7.5		63.2	36.7					1.1	-2.27	1,2,4

NOTES: Initial Dry Density and initial Water Content are in-situ values unless otherwise noted.
NP = Non-plastic

REMARKS – Collapse / Compression

1. Submerged to approximate saturation.
2. Sample disturbance observed.
3. Slight rebound after saturation.
4. Additional compression after saturation.

Western Technologies
An RMA Company

PROJECT: LIFE TIME ATHLETIC COUNTRY CLUB - HERRIMAN
JOB NO.: 61-224216-0

PLATE
B-4

SOIL PROPERTIES

Boring No.	Sample Depth (ft)	USCS Class.	Initial Dry Density (pcf)	Initial Water Content (%)	Percent Passing		Atterberg Limits		Collapse/Compression Properties			Remarks
					#4	#200	LL	PI	Surcharge (ksf)	Total Compression (%)		
										In-Situ	After Saturation	
AB-9	2.5		66.5	23.5					1.0	-1.91	-7.38	1,2,4
	5		70.0	18.7					1.08	-0.99	-3.65	1,4
	7.5		57.9	50.7					1.1	-3.85	-5.69	1,4
AB-10	2.5		73.3	23.2					1.08	2.10	-2.56	1,4
	5		70.2	25.2					1.0	2.85	0.89	1,4
	7.5		92.2	23.7					1.08	-0.09	-0.09	1
AB-11	7.5		60.0	48.4					1.68	-2.33	-2.09	1,3
	10		72.1	38.4					1.68	-3.13	-3.11	1,3
AB-12	2.5		70.3	13.4					1.7	-5.19	-8.10	1,4
	5		64.1	14.1					1.7	-4.79	-11.67	1,2,4
	7.5		71.1	35.4					1.68	-4.58	-5.27	1,4
	10		63.9	34.1					1.68	-2.66	-2.21	1,3
AB-13	2.5		72.9	9.15					1.7	-2.45	-5.33	1,4
	5		71.1	20.7					1.7	-3.23	-7.42	1,4
	7.5		50.5	39.1					1.7	-1.48	-2.86	1,2,4
	10		72.6	31.4					1.68	-1.24	-1.81	1,4
AB-14	2.5		58.9	17.6					1.7	-2.41	-7.47	1,2,4
	5		63.9	26.3					1.7	-4.15	-7.16	1,4
	7.5		65.1	43.1					1.68	-2.74	-2.90	1,4
AB-15	2.5		74.5	20.2					1.7	-1.70	-3.22	1,4
	5		89.6	24.3					1.68	-2.43	-2.98	1,4

NOTES: Initial Dry Density and initial Water Content are in-situ values unless otherwise noted.
NP = Non-plastic

REMARKS – Collapse / Compression

1. Submerged to approximate saturation.
2. Sample disturbance observed.
3. Slight rebound after saturation.
4. Additional compression after saturation.

Western Technologies
An RMA Company

PROJECT: LIFE TIME ATHLETIC COUNTRY CLUB - HERRIMAN
JOB NO.: 61-224216-0

PLATE
B-5

SOIL PROPERTIES

Chemtech-Ford Laboratories
Serving the Intermountain West Since 1953

9632 South 500 West
Sandy, UT 84070
O:(801) 262-7299 F: (866) 792-0093
www.ChemtechFord.com

Certificate of Analysis

Western Technologies
Warren Clyde
420 West Lawndale Drive
Salt Lake City, UT 84115

PO#:
Receipt: **1/24/25 15:06 @ 20.3** °C
Date Reported: 1/31/2025
Project Name: **Lifetime - Herriman - 61-224216**

Sample ID: **B20-0' 61-224216**

Matrix: **Solid**
Lab ID: **25A1782-01**
Date Sampled: **1/22/25 12:00**
Sampled By: **Client**

	Result	Units	Minimum Reporting Limit	Method	Preparation Date/Time	Analysis Date/Time	Flag(s)
Inorganic							
Sulfate, Soluble (IC)	81	mg/kg dry	12	EPA 300.0	1/27/25	1/27/25	
Total Solids	82.4	%	0.1	CTF8000	1/27/25	1/27/25	

Chemtech-Ford Laboratories
Serving the Intermountain West Since 1953

9632 South 500 West
Sandy, UT 84070
O:(801) 262-7299 F: (866) 792-0093
www.ChemtechFord.com

Certificate of Analysis

Western Technologies
Warren Clyde
420 West Lawndale Drive
Salt Lake City, UT 84115

PO#:
Receipt: **1/24/25 15:06 @ 20.3** °C
Date Reported: 1/31/2025
Project Name: **Lifetime - Herriman - 61-224216**

Report Footnotes

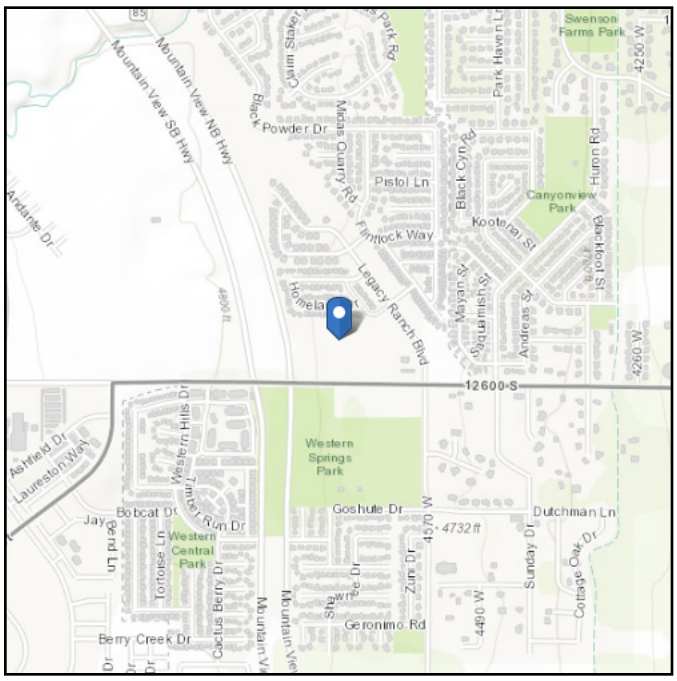
Abbreviations

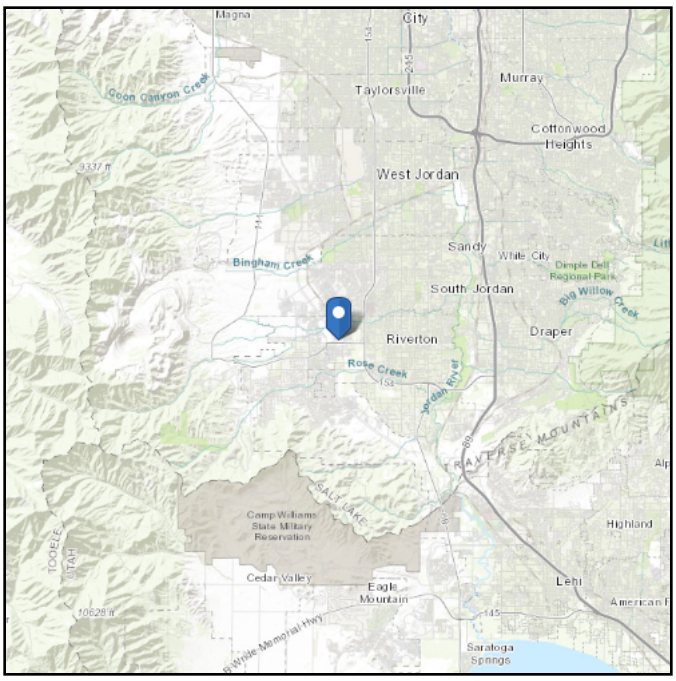
ND = Not detected at the corresponding Minimum Reporting Limit (MRL).
1 mg/L = one milligram per liter or 1 mg/kg = one milligram per kilogram = 1 part per million.
1 ug/L = one microgram per liter or 1 ug/kg = one microgram per kilogram = 1 part per billion.
1 ng/L = one nanogram per liter or 1 ng/kg = one nanogram per kilogram = 1 part per trillion.
On calculated parameters, there may be a slight difference between summing the rounded values shown on the report vs the unrounded values used in the calculation.

ASCE Hazards Report

Address:
No Address at This Location

Standard:	ASCE/SEI 7-16	**Latitude:**	40.52356
Risk Category:	II	**Longitude:**	-112.00301
Soil Class:	C - Very Dense Soil and Soft Rock	**Elevation:**	4749.255795404658 ft (NAVD 88)





Seismic

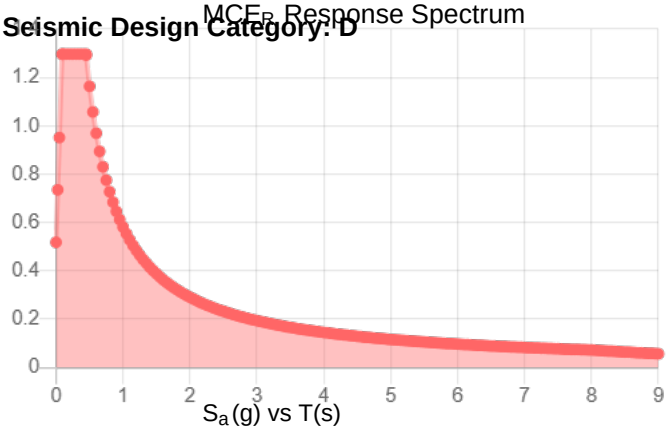
Site Soil Class: C - Very Dense Soil and Soft Rock

Results:

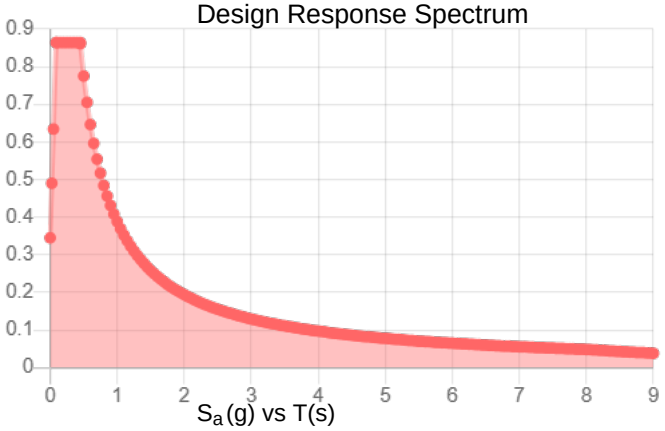
S_S :	1.08	S_{D1} :	0.388
S_1 :	0.388	T_L :	8
F_a :	1.2	PGA :	0.474
F_v :	1.5	PGA_M :	0.568
S_{MS} :	1.296	F_{PGA} :	1.2
S_{M1} :	0.581	I_e :	1
S_{DS} :	0.864	C_v :	1.116

Seismic Design Category: D

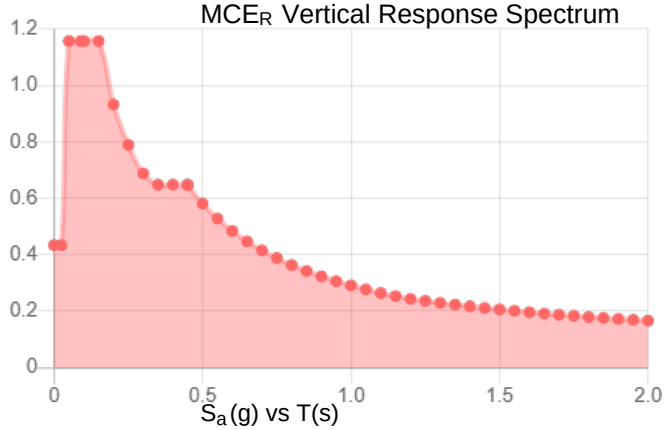
MCE_R Response Spectrum



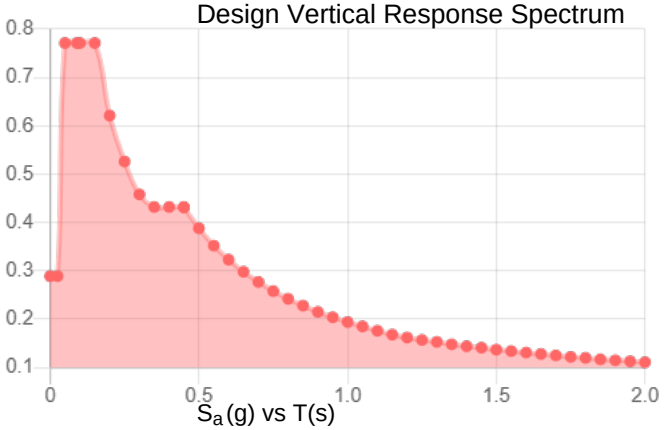
Design Response Spectrum



MCE_R Vertical Response Spectrum



Design Vertical Response Spectrum



Data Accessed: **Thu Mar 06 2025**

Date Source:

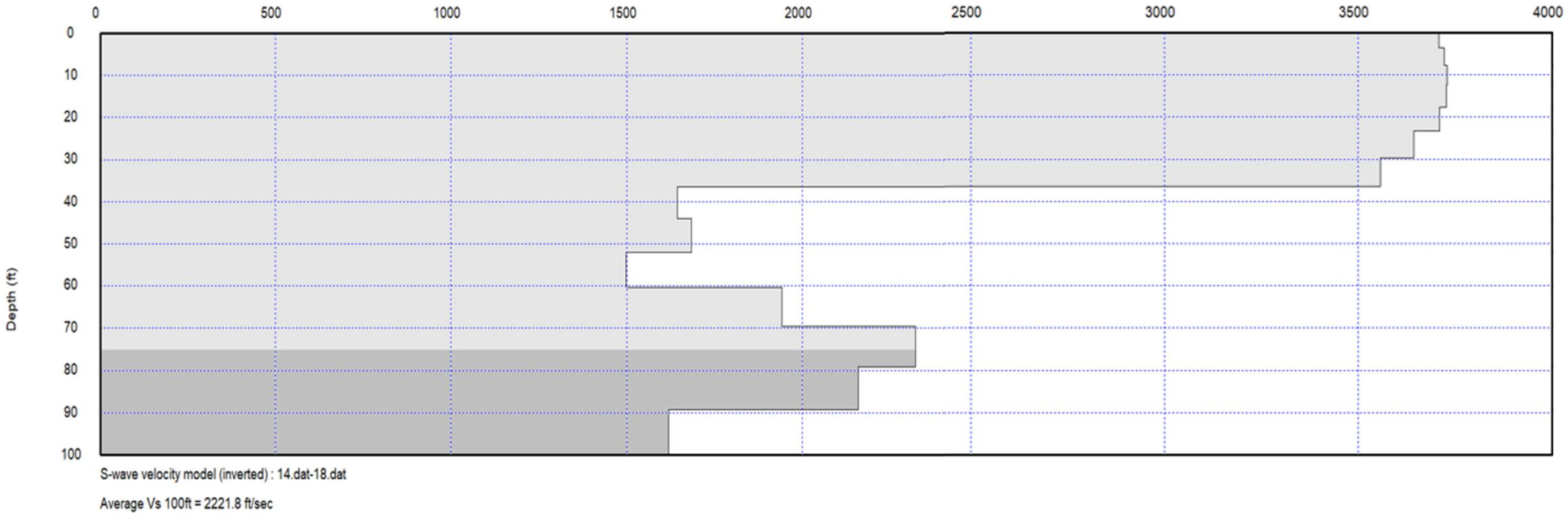
USGS Seismic Design Maps based on ASCE/SEI 7-16 and ASCE/SEI 7-16 Table 1.5-2. Additional data for site-specific ground motion procedures in accordance with ASCE/SEI 7-16 Ch. 21 are available from USGS.

The ASCE Hazard Tool is provided for your convenience, for informational purposes only, and is provided “as is” and without warranties of any kind. The location data included herein has been obtained from information developed, produced, and maintained by third party providers; or has been extrapolated from maps incorporated in the ASCE standard. While ASCE has made every effort to use data obtained from reliable sources or methodologies, ASCE does not make any representations or warranties as to the accuracy, completeness, reliability, currency, or quality of any data provided herein. Any third-party links provided by this Tool should not be construed as an endorsement, affiliation, relationship, or sponsorship of such third-party content by or from ASCE.

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APPENDIX C



Seismic Site Classification – “C”

Western Technologies
An RMA Company

PROJECT: LIFE TIME ATHLETIC COUNTRY CLUB - HERRIMAN
REFERENCE NO.: 61-224216-0

SHEAR WAVE VELOCITY PROFILE

PLATE

C-1

SECTION 00 40 00
CONTRACT PACKET FORMS

PART 1 - GENERAL

1.01 USE OF INFORMATION PROVIDED

A. Bidders are urged to examine the information provided, make their own investigation of the Sample Contracts, required insurances, and forms before bidding, and obtain additional information should they desire.

1.02 CONTRACT PACKET FORMS

A. The General Contractor will furnish a “Bid Manual” that will contain relevant project information, directives and forms for the work.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

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SECTION 00 4323
ALTERNATES FORM

PARTICULARS

1.1 THE FOLLOWING IS THE LIST OF ALTERNATES REFERENCED IN THE BID SUBMITTED BY:

1.2 (BIDDER) _____

1.3 TO (OWNER): _____

1.4 DATED _____ AND WHICH IS AN INTEGRAL PART OF THE BID FORM.

ALTERNATES LIST

2.1 THE FOLLOWING AMOUNTS SHALL BE ADDED TO OR DEDUCTED FROM THE BID AMOUNT. REFER TO SECTION 01 2300 - ALTERNATES.

ALTERNATE # 01: ADD / (DEDUCT) $ _____

END OF SECTION

SECTION 00 43 25

SUBSTITUTION REQUEST FORM

1.1 SUBSTITUTION REQUESTS

Life Time Property Development welcomes and encourages substitution requests in order to reduce costs. Any and all substitution requests should be considered an equal to the work identified and products specified. All substitutions shall be identified and submitted with their Bid using the substitution request form that is attached to this Section. If a sample submission is required by the product specification, submit the sample along with the substitution request.

SUBSTITUTION REQUEST FORM

To: **Life Time Construction**
2900 Corporate Place
Chanhassen, MN 55317 PH: (952) 229-7521 FAX: (952) 995-0276

SECTION #	PARA #	SPECIFIED PRODUCT	PROPOSED SUBSTITUTION

REASON FOR SUBSTITUTION: _____

_____

ATTACH COMPLETE TECHNICAL DATA, LITERATURE AND SAMPLE IF APPLICABLE

A. Does proposed substitution fail to satisfy, in any respect, characteristics specified for original product(s)? ..... [Y] [N]

B. Does substitution affect dimensions shown on drawings? ..... [Y] [N]

C. Does substitution affect other trades? ..... [Y] [N]

D. Does warranty differ from that specified? ..... [Y] [N]

E. Does substitution affect the schedule ..... [Y] [N]

F. Does substitution affect cost to Owner? ..... [Y] [N]

If so, how much? Add $_____ Deduct $_____

G. If you indicated "Yes" to any of the items above, attach thorough explanation on your Company letterhead as follows:

a. Explain any differences between proposed substitution and specified product.

b. Summarize experience with product and manufacturer in Project area.

The undersigned states that the function, appearance and quality of the Proposed Substitution are equivalent or superior to the Specified Item. The undersigned agrees that, if necessary, in the sole opinion of the Architect/Engineer, to make this product perform as intended all additional costs shall be paid by the contractor.

		For use by Architect:	
Submitted by:	_____	Accepted:	___
Position:	_____	Accepted As Noted:	___
Company:	_____	Not Accepted:	___
Address:	_____	Received Too Late:	___
	_____		
Date:	_____	By	_____

Telephone:	_____	Date	_____
Signature:	_____	Remarks	_____

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SECTION 00 52 00
AGREEMENT FORM

PART 1 GENERAL

1.01 FORM OF AGREEMENT

A. The Agreement to be executed is attached following this page.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 00 5433

AGREEMENT CONCERNING DRAWING FILES ON ELECTRONIC MEDIA

PART 1 - GENERAL

1.1 AGREEMENT CONCERNING DRAWING FILES ON ELECTRONIC MEDIA

A. The electronic files will be distributed from the Architect to the Construction Manager/General Contractor only once the following form has been signed. It will be the General Contractor's responsibility to control distribution.

B. Valentiner Crane Brunjes Onyon Architects, L.L.C. (the Architect) does not assume any responsibility for the accuracy of the information contained in these drawing files. Any and all users are aware that differences may exist between the electronic files delivered and the printed hard-copy construction documents. In the event of a conflict between the signed and sealed hard-copy construction documents prepared by the Architect and the electronic files, the signed or sealed hard-copy construction documents shall govern.

C. Any and all users who may obtain these drawings **from the Construction Manager/General Contractor** under this agreement, including but not limited to, subcontractors, vendors, suppliers etc., agree to indemnify and hold harmless the Architect, its officers, directors, employees and sub-consultants against all damages, liabilities or costs, including reasonable attorneys' fees and defense costs, arising from any changes made by anyone other than the Architect or from any transfer or reuse of the electronic files including data contained in the files without the prior written consent of the Architect.

D. Building Information Model (BIM) drawing files will be made available to the Construction Manager/General Contractor and its subcontractors for the purposes of preparing submittals for their portion of the work **only** after the "Agreement Concerning Drawing Files on Electronic Media" has been signed by the Construction Manager/General Contractor.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION – Not Used

END OF SECTION

AGREEMENT CONCERNING DRAWING FILES ON ELECTRONIC MEDIA

Valentiner Crane Brunjes Onyon Architects, L.L.C. (the Architect) does not assume any responsibility for the accuracy of the information contained in these digital models. Any and all users are aware that differences may exist between the electronic files delivered and the printed hard-copy construction documents. In the event of a conflict between the signed and sealed hard-copy construction documents prepared by the Architect and the electronic files, the signed or sealed hard-copy construction documents shall govern.

Any and all users who may obtain these digital models from the Construction Manager/General Contractor under this agreement, including but not limited to; subcontractors, vendors, suppliers etc., agree to indemnify and hold harmless the Architect, its officers, directors, employees and sub-consultants against all damages, liabilities or costs, including reasonable attorneys' fees and defense costs, arising from any changes made by anyone other than the Architect or from any transfer or reuse of the electronic files without the prior written consent of the Architect.

Under no circumstances shall delivery of the electronic digital models be deemed a sale by the Architect, and the Architect makes no warranties, either express or implied, of merchantability and fitness for any particular purpose. In no event shall the Architect be liable for any loss of profit or any consequential damages as a result of the use or reuse of the electronic files.

The digital Building Information Models provided will contain information as provided on construction documents. The user shall remove all notes, text, detail cuts and member designations from the electronic file prior to use. If used as submittal documents, submittals will be rejected as non-compliant. The drawing files provided by VCBO may not be reproduced or distributed to individuals outside the company or collective organization signing this agreement.

LIST OF DRAWINGS:

Project Name: **LIFE TIME HERRIMAN HEALTH CLUB**
VCBO Project # **25085.00**

List of Revit Models: **Architectural, Structural, Mechanical and Electrical.**

_____

ACCEPTANCE OF TERMS, CONDITIONS & LIMITATIONS:

_____ _____
Name of Company/Contractor Signature of Company/Contractor Representative

_____
Printed Name of Individual Signing

_____ _____
Position/Title Date

This agreement must be signed and returned to VCBO prior to release of any electronic document.

SECTION 00 72 00
GENERAL CONDITIONS

PART 1 GENERAL

1.01 FORM OF GENERAL CONDITIONS

A. The General Conditions applicable to this contract is attached following this page.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 01 11 00
SUMMARY OF WORK

PART 1 GENERAL

1.01 GENERAL INFORMATION

A. A basic summary description of the project is as follows:

An approximately 106,000 SF health club comprising of two above ground levels and an outdoor pool deck and pickleball courts. Project facilities to include indoor & outdoor pools, café, fitness equipment, office, spa, short-term childcare, and gymnasium.

B. General contract information, procedures, requirements, restrictions, directions and forms for all subcontractors will be provided by the Owner prior to work.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 01 2300
ALTERNATES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Administrative and procedural requirements for alternates.

B. Procedures for pricing Alternates.

1.2 RELATED REQUIREMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this section.

B. Document 00 4323 - Alternates Form: List of Alternates as supplement to Bid Form.

C. Document 00 5200 - Agreement Form: Incorporating monetary value of accepted Alternates.

1.3 DEFINITIONS

A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the Bidding Requirements that may be added to or deducted from the Base Bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

B. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to Co

1.4 ACCEPTANCE OF ALTERNATES

A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at Owner's option. Accepted Alternates will be identified in the Owner-Contractor Agreement.

B. Coordinate related work and modify surrounding work to integrate the Work of each Alternate.

1.5 PROCEDURES

A. Coordination: Modify or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.

B. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.

C. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated modification ot alternates.

D. Execution of Work: Execute accepted alternates under the same conditions as other work of the Contract.

E. Schedule: A Schedule of Alternates is included at the end of this section. Specification sections referenced in schedule contain requriements for materials necessary to achieve the work described under each alternate.

1.6 SCHEDULE OF ALTERNATES

A. Alternate #01
   1. Base Bid Item: As listed in Section 07 13 25– Self-Adhering (Post-Applied) Sheet Waterproofing.
   2. Alternate Bid Item: As listed in Section 07 14 50 – Fluid-Applied Waterproofing Membrane.

B. Alternate #02
   1. Base Bid Item: As listed in 07 27 00 - Sheet-Applied Membrane Air Barriers
      Alternate Bid Item: As listed in 07 27 26 - Fluid-Applied Membrane Air Barrier

C. Alternate #03
   1. Base Bid Item: As listed in 07 54 23 - Thermoplastic Polyolefin (TPO) Roofing
      Alternate Bid Item: Providing roofing equivalent for same criteria for a PVC roof membrane.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 31 00
PROJECT MANAGEMENT AND COORDINATION

PART 1 GENERAL

1.01 SUMMARY

A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
   1. Coordination drawings.
   2. Requests for Information (RFIs).
   3. Project Web site.
   4. Project meetings.

1.02 RELATED SECTIONS:

A. 01 31 00.05 - Project BIM Coordination for work to be coordinated by Building Information Management software.

B. 01 77 00 - "Closeout Procedures" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.

1.03 DEFINITIONS

A. RFI: Request for Information; a request for an owner, architect and contractor to request further information from each other during construction.

B. PR: Proposal Request; a request to the contractor for price and time quotations related to a proposed change in the construction contract.

C. CCD: Construction Change Directive; a directive for changes in the Work for use where the owner and contractor have not agreed on proposed changes in the contract sum or contract time. Upon receipt of a CCD, the contractor must promptly proceed with the change in the Work described therein.

D. ASI: Architect's Supplemental Instruction; a means for the Architect to provide additional instructions, interpretations, or order minor changes in the Work that do not constitute a change to the contract sum or contract time.

1.04 COORDINATION

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, that depend on each other for proper installation, connection, and operation.
   1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
   2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
   3. Make adequate provisions to accommodate items scheduled for later installation.

B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
   1. Prepare similar memoranda for separate Subcontractors if coordination of their Work is required.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures via Owner-approved and provided project management website/software with other construction activities and activities of other Subcontractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
   1. Preparation of contractor's construction schedule and its coordination with the Owner's milestones.
   2. Preparation of the schedule of values.
   3. Installation and removal of temporary facilities and controls.

4. Delivery and processing of submittals.
5. Special Inspections.
6. Progress meetings.
7. Pre-installation conferences.
8. Facilitate weekly project team meetings.
9. Startup and adjustment of systems.
10. Project closeout activities.

1.05 COORDINATION DRAWINGS AND BIM MODELS

A. Coordination Drawings, General: Prepare coordination drawings in accordance with requirements in individual Sections, where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
   1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
      a. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
      b. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

B. Coordination Drawing Organization: Organize coordination drawings as follows:
   1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire protection, fire alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid.
   2. Plenum Space: Indicate sub-framing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures indicated on Drawings.
   3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire protection, fire alarm, and electrical equipment.
   4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
   5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes as well as locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
   6. Review: General Contractor (GC) and Owner's Representative (OR), or agent thereof, will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are the Subcontractor's responsibility.

C. Coordination BIM Models: See Section 01 31 00.05 Project BIM Coordination.

1.06 REQUESTS FOR INFORMATION (RFI)

A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Subcontractor shall prepare and submit an RFI in the form specified.
   1. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Subcontractor's work.
   2. Submit RFIs electronically via Procore software system.
      a. General Contractor (GC) will assign each subcontractor a site username and password once contract documents have been executed. An email will be sent to the subcontractor with information and directions for the site access.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
   1. Project name.
   2. Project number.
   3. Name of Subcontractor.
   4. RFI number, numbered sequentially.

5. RFI subject.
6. Specification Section number and title and related paragraphs, as appropriate.
7. Drawing number and detail references, as appropriate.
8. Field dimensions and conditions, as appropriate.
9. Subcontractor's suggested resolution. If Subcontractor's solution(s) impacts the Subcontractor Time or the Subcontractor Price, Subcontractor shall state impact in the RFI.
10. Subcontractor's signature.
11. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.

C. RFI Forms: Submit electronically via Procore software system.

D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow 3-5 working days for General Contractor's response for each RFI, or up to 10 working days for RFIs requiring coordination with multiple disciplines. RFIs received by General Contractor after 1:00 p.m. will be considered as received the following working day.
   1. The following RFIs will be returned without action:
      a. Requests for approval of submittals.
      b. Requests for approval of substitutions.
      c. Requests for coordination information already indicated in the Contract Documents.
      d. Requests for adjustments in the Subcontractor Time or the Subcontractor Price.
      e. Requests for interpretation of general Contractor's actions on submittals.
      f. Incomplete RFIs or inaccurately prepared RFIs.
   2. Architect's action may include a request for additional information, in which case the time for response will date from time of receipt of additional information.
   3. Architect's action on RFIs that may result in a change to the Subcontractor Time or the Subcontractor Price may be eligible for Subcontractor to submit Change Proposal according to conditions of the contract and as otherwise specified.
      a. If Subcontractor believes the RFI response warrants change in the Subcontractor Time or the Subcontractor Price, notify the Architect and Owner's Representative in writing within 5 days of receipt of the RFI response.

1.07 PROJECT WEB SITE

A. All project coordination will be handled via email and other digital methods as advised. Provide email addresses for all appropriate project staff.

1.08 PROJECT MEETINGS

A. General: General Contractor will schedule and conduct meetings and conferences at Project site, unless otherwise indicated.

B. Preconstruction Conference: General Contractor will schedule and conduct a preconstruction conference before starting construction.
   1. Attendees: Architect, Owner's Representative, General Contractor, Subcontractor's Project Manager and its superintendent; major Subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
   2. Agenda: Discuss items of significance that could affect progress, including the following:
      a. Tentative construction schedule.
      b. Phasing.
      c. Critical work sequencing and long-lead items.
      d. Designation of key personnel and their duties.
      e. Procedures for processing field decisions and Change Orders.
      f. Procedures for RFIs.
      g. Procedures for testing and inspecting.
      h. Procedures for processing Applications for Payment.
      i. Distribution of the Contract Documents.

j. Submittal procedures.
k. Sustainable design requirements.
l. Preparation of record documents.
m. Use of the premises.
n. Work restrictions.
o. Working hours.
p. Owner's occupancy requirements.
q. Responsibility for temporary facilities and controls.
r. Procedures for moisture and mold control.
s. Procedures for disruptions and shutdowns.
t. Construction waste management and recycling.
u. Parking availability.
v. Office, work, and storage areas.
w. Equipment deliveries and priorities.
x. First aid.
y. Security.
z. Progress cleaning.
aa. Safety
bb. Owner Requirements

3. Minutes: General Contractor will record and distribute meeting minutes.

C. Pre-installation Conferences: General Contractor shall conduct a pre-installation conference at Project site before each construction activity that requires coordination with other construction.
1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise General Contractor, Architect, and Owner’s Representative of scheduled meeting dates.
2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
a. Contract Documents.
b. Options.
c. Related RFIs.
d. Related Change Orders.
e. Purchases.
f. Deliveries.
g. Submittals.
h. Review of mockups.
i. Possible conflicts.
j. Compatibility problems.
k. Time schedules.
l. Weather limitations.
m. Manufacturer's written recommendations.
n. Warranty requirements.
o. Compatibility of materials.
p. Acceptability of substrates.
q. Temporary facilities and controls.
r. Space and access limitations.
s. Regulations of authorities having jurisdiction.
t. Testing and inspecting requirements.
u. Installation procedures.
v. Coordination with other work.
w. Required performance results.
x. Protection of adjacent work.
y. Protection of construction and personnel.

z. Safety Action Plan.
aa. Site Coordination.

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

D. Progress Meetings: General Contractor will conduct progress meetings at weekly intervals.
1. Attendees: In addition to the Architect, Owner's Representative, and General Contractor, each Subcontractor, Sub-Subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
   a. Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed so as not to delay the completion of the Project.
      1) Review schedule for next period.
   b. Review present and future needs of each entity present, including the following:
      1) Interface requirements.
      2) Sequence of operations.
      3) Status of submittals.
      4) Deliveries.
      5) Off-site fabrication.
      6) Access.
      7) Site utilization.
      8) Temporary facilities and controls.
      9) Progress cleaning.
      10) Quality and work standards.
      11) Status of correction of deficient items.
      12) Field observations.
      13) Status of testing and inspections.
      14) Status of RFIs.
      15) Status of proposal requests.
      16) Pending changes.
      17) Status of Change Orders.
      18) Pending claims and disputes.
      19) Documentation of information for payment requests.
      20) Safety.
      21) Site Clean Up.
3. Minutes: General Contractor will record and distribute the meeting minutes to each party present and to parties requiring information.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 01 31 01
PROJECT BIM COORDINATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Building Information Modelling Standards and Coordination.
   1. Protocols for 3D Coordination.
   2. Model content and expected Level of Detail.
   3. Model Element Scope.

1.02 RELATED REQUIREMENTS

A. Section 01 31 00 - Project Coordination.

B. Section 01 77 00 - Closeout Procedures: Project record documents, operation and maintenance (O&M) data, warranties and bonds.

C. Division 5 - Metals: See below for scope.

D. Section 11 40 00 - Food Service Equipment

E. Division 21 - Fire Suppression: See below for scope.

F. Division 22 - Plumbing: See below for scope.

G. Division 23 - Heating, Ventilation and Air Conditioning (HVAC): See below for scope.

H. Division 26 - Electrical: See below for scope.

I. Division 32 - Exterior Improvements: See below for scope.

1.03 ADDITIONAL CONTRACTING CONDITIONS

A. BIM modelling and coordination is a condition of the contract and the cost to the subcontractor is to be included in the cost of construction.

B. This specification is written with the assumption that Life Time is serving as General Contractor. When this is not the case, the General Contractor shall take on the role of BIM Model Coordinator.

C. Failure by Subcontractors to uphold the obligations specified herein shall be considered a material breach of the Subcontract.
   1. In the event of any such breach, Life Time may, upon 48 hours' notice to Subcontractor, supplement Subcontractor's work required herein at Subcontractor's expense and exercise any and all other remedies provided under the Subcontract or applicable law.
      a. Subcontractor will be liable for lost time to Life Time or other Subcontractors.
      b. Subcontractor will be liable to correct any improperly coordinated work, whether by themselves or by other Subcontractors.

D. Submission of required models in a timely manner and their coordination serves to reserve space for each Subcontractor to install their Scope of Work components.
   1. Subcontractors who fail to completely submit their models in a timely manner shall be required to move their components, at their own expense, in the event of conflict with another Subcontractor.

1.04 DEFINITIONS

A. **Building Information Model.** A Building Information Model is a digital representation of the physical and functional characteristics of the Project which encompasses building geometry, spatial relationships, geographic information, and quantities and properties of building components. The Building Information Model is herein referred to as the "Model(s)". "Building Information Modeling" (BIM) refers to the methodology and technology used to create the Model. The following types of models will be used during the coordination effort:
   1. **Design Models.** Design Models are provided by Life Time to the subcontractors that includes both the Architectural and Structural elements of the Project. This model will be created by the

Architect and Engineer of Record. The Level of Detail of the Base Construction Model shall be established prior to the BIM Kickoff Meeting.

2. **Coordination Model.** The Coordination Model is the Model that will be reviewed by Life Time and its subcontractors on an ongoing basis until the time a "Sign-off Model" is completed. This Model will include the design models and Subcontractor Model Elements that have been provided.
3. **Sign-off Model.** The Sign-off Model is the final Coordination Model which becomes the basis for construction from which shop drawings and field drawings are to be produced. This Model may consist of the entire Project or only an area or level of the Project.
4. **As-Built Model.** A Model that reflects the As-Built condition of the Project. This Model type will be used following coordination to represent the install condition of the Model Elements. It will include the Base Construction Model and all Subcontractor Model Elements.

B. **Clash Detection.** Clash Detection tools enable effective identification, inspection, and reporting of interference clashes in a 3D project model.

C. **Level of Detail.** The Level of Detail (LOD) describes the particular level of completeness to which a Model Element or Subcontractor Scope of Work is to be developed. Further information is found in the AGC BIM Specification (2016).

D. **Model Element.** A Model Element is a portion of the Building Information Model representing a component, system or assembly within a building. For the purposes of this Specification, Model Elements are represented by the different systems included in each Subcontractor's Scope of Work.

E. **Model Element Author.** The Model Element Author (MEA) is the party responsible for developing the content of a specific Model Element to the LOD required for Subcontractor's particular scope of Work on the project. Model Element Author refers to the subcontractor responsible for an identified Scope of Work.

F. **Navisworks® Freedom.** Autodesk® Navisworks® Freedom software is the free viewer for files in the Navisworks® NWD and 3D DWF formats. Navisworks® Freedom is to be utilized by the Model Element Author to review clashes between Model Elements.

G. **Navisworks® Manage.** Autodesk® Navisworks® Manage software will be used to create a single Model of the Project from the individual Model Elements developed by the Model Element Authors to provide a real-time project view for effective 3D Coordination and 4D planning. Navisworks® Manage provides the tools to optimize interoperability between all types of models, regardless of format or file size, and perform Clash Detection for coordination review.

H. **Object Enabler.** A downloadable module that 'translates' the BIM model custom objects into a language that other software applications understand.

1.05 REFERENCE STANDARDS

A. AGC BIM Level of Specification - AGC BIM LoS; 2016.

B. NBIMS-US v3 - National BIM Standards-US; Version 3.

C. NCS v6 - National CAD Standards (NCS); Version 6.

1.06 ADMINISTRATIVE REQUIREMENTS

A. Coordination Protocol:
   1. Kick-off Meeting:
      a. After award, a 3D Coordination protocol meeting shall be held.
      b. All Subcontractors to be involved in the 3D Coordination effort are required to attend. Attendees shall include at least one Project Manager and one member of the 3D modeling team from each Subcontractor.
      c. Coordination requirements, Schedule, Standards and other related items shall be discussed.
   2. Training:
      a. Life Time may, at its discretion, provide basic coordination training for all coordination team members (if necessary).

b. Complete, accurate, and timely modeling and submission of Subcontractor's work shall remain the responsibility of Subcontractor.

3. Internal Coordination:
   a. The Subcontractor's Model Elements shall be internally coordinated prior to submitting to Life Time.
   b. Internal Coordination shall include all elements of the Subcontractor's Scopes of Work, any existing work of the same Scopes of Work as the subcontractor's, or connections to other Scopes of Work by the Subcontractor.
4. Coordination with Provided Information:
   a. The Subcontractor's Model Elements shall be coordinated with the provided information prior to submitting to Life Time.
   b. Coordination shall include all elements of the Base Construction Model, adherence to any plenum / underground hierarchy diagrams on the project, and any available Trade / Subcontractor models of other Scopes of Work in provided Coordination Models.
   c. All subcontractors shall coordinate their scopes of work with the contract documents.
5. Conflict Corrections:
   a. The Model Element Authors shall correct all assigned Model Element conflicts discovered during or after Life Time's review of submitted models or Coordination meetings prior to the following submittal deadline or coordination meeting.
6. Model Management:
   a. Life Time will facilitate the Coordination Process throughout the duration of the Project. Life Time will provide the following:
      1) Model Coordinate System (Origin, Orientation and Units)
      2) Collaboration Site (Setup and Maintenance)
      3) Process for transferring and accessing Model files.
      4) Naming Conventions for subcontractor file names
      5) Typical Plenum Hierarchy Diagram
      6) Coordination Schedule. A detailed schedule for 3D coordination will be coordinated with the overall project schedule. This schedule will be issued at the time of the Kick-off meeting.
   b. During the project, Lifetime will manage the following processes:
      1) Coordinate submission and exchange of Models
         (a) Validate that files are complete, usable and in compliance with applicable protocols
         (b) Maintain record copy of each file received
      2) Create Coordination Model
      3) Perform Clash Detection between trades
      4) Facilitate Coordination Meetings
      5) Issue Requests for Information for conflicts requiring Design Team input
      6) Publish Coordination Meeting models and reports for subcontractor review and resolution
      7) Maintain an updated coordination schedule
      8) Maintain Sign-Off Models and As-Built Models.
7. Model Ownership:
   a. All Models submitted to or by Life Time may be used as needed by the Project Team; however, only the original Model Author has the right to modify Model content.
   b. By submitting content for the Model, Life Time and/or the Subcontractor does not grant any ownership right in the content provided or in the software used to produce content.
   c. In addition to the uses defined in this Specification (design, coordination, fabrication, and construction of the Project) these Models may also be used for other purposes such as 4D scheduling and facility maintenance by either Life Time or Owner.
8. Collaboration Site:
   a. All file transfers for coordination will be via the file sharing site provided by Life Time.
   b. The standard file sharing location for Life Time is Microsoft One Drive.

9. Clash Detection:
    a. Prior to established deadlines or Coordination Meetings, Navisworks will be used to identify conflicts between trades.
    b. Additional issues and clashes may also be found while virtually walking the Project. Subcontractors are responsible for performing internal and external coordination as defined in 1.06A4 prior to submitting models to Life Time.
10. Clash Viewpoints:
    a. Clashes and issues will be documented in the model and provided to all Coordination team members as a basis for tracking progress in the coordination process. These viewpoints will be provided after Life Time's review of subcontractor submissions or after scheduled Coordination Meetings.
    b. Clashes and issues will all receive a number, and a designation of which company is responsible for the resolution.
    c. If an RFI is issued in the process of resolving a clash or issue, the RFI# will also be noted in the Clash Report. Subcontractors will resolve all documented clashes and issues in the reports prior to the following submittal deadline or Coordination meeting.
    d. The viewpoints will serve as a basis for tracking performance of the coordination process.
11. Model and Report Distribution:
    a. Life Time will provide the Coordination Model and Clash Report to each Subcontractor via the Collaboration Site for their review and use in the External Coordination process or to make the required changes to their Model Elements after Coordination Meetings and other deadlines as defined by the BIM Coordination Schedule.
12. External Coordination:
    a. As Subcontractor models are added to the Coordination Model, the Subcontractor will use the Coordination Model and Clash Reports provided to coordinate their Scope of Work with all other Subcontractors' Scopes of Work.
    b. Subcontractor shall communicate with the other trades / subcontractors to resolve clashes that do not require Life Time's involvement as a facilitator.
    c. Each subcontractor shall make the necessary changes and upload their revised models to confirm that the conflicts are resolved.
    d. Submission deadlines for these externally coordinated models shall be in accordance with the Coordination Schedule established by Life Time and as otherwise required by Life Time in the Coordination Schedule.
    e. Life Time will confirm that submitted models meet the internal and external coordination requirements prior to the scheduled Coordination Meeting.
13. Coordination Meetings:
    a. The Subcontractor shall be prepared to accommodate Coordination meetings to resolve model conflicts.
        1) The scheduled meetings will take place on the jobsite at a location and time to be determined by the Project Team and may consist of either recurring meetings or 2 or 3 day work sessions.
    b. During each meeting the current Coordination Model will be reviewed by virtually walking the Project and discussing conflicts found using Clash Detection and model viewing tools.
    c. Each conflict found will be discussed with all involved parties to determine the best solution, with Life Time acting as the facilitator for those discussions.
        1) Attendees shall include at least one Model Element Author from each Subcontractor who clearly understands the defined Scope of Work and is able to make decisions about changes to the Scope of Work in the meeting.
    d. Coordination Meetings may be conducted via Online Meeting depending on the location and accessibility of the jobsite by the Subcontractors. This will be determined by Life Time and will be based on the productivity of past online meetings.
14. Sign-Off Model:
    a. Upon completion of Coordination, Subcontractor shall provide a model of the condition of their Scope of Work.

b. Model Elements shall be updated to include changes made by 1) Requests for Information, 2) Design changes by Architect / Engineer, 3) Submittal comments and revisions on approved shop drawings, and 4) As-Built field modifications.
c. After all conflicts have been corrected and/or Life Time and the Subcontractors agree that the area defined by the Coordination Model has been sufficiently coordinated, all parties will sign-off on the defined area using the 3D Coordination Sign-Off document (Attachment A).
d. This final Coordination Model then becomes the Sign-Off Model for the defined area. Any unresolved clashes or issues in this area that require further review (due to delayed responses or expected contract document changes) should be noted on the document.
e. The Subcontractor agrees to be responsible for locating their respective systems based on the Sign-Off Model.
    1) Any variation from this Sign-Off Model must be coordinated with Life Time.
    2) Components that are installed in conflict with the Sign-Off Model layout and create obstacles or additional work for other disciplines shall require one of the following: a) removal and reinstallation per model, or b) monetary compensation to the affected party.

15. Model Revisions:
    a. If the contract documents or the Subcontractor's Scope of Work are modified after the Sign-Off Model has been completed, the Subcontractor shall include costs within their Change Order to modify and re-coordinate the affected Model Elements in the modified areas.
    b. Substantial changes involving multiple trades may require additional Coordination Meetings, a new Sign-Off Model, and another Sign Off document.
    c. All coordination costs associated with the changes must be included in the Change Order for the changed Scope of Work. Subcontractor must notify the Project Model Manager of any changes to floors which have already been signed-off.
16. Shop Drawing Submittals of affected scopes of work:
    a. All submittals for affected Scopes of Work shall conform with the approved Sign-Off Model.
    b. See "Submittals" below.
17. Field/Installation Documents
    a. Field/Installation documents are to be based on the approved Sign-Off Model and are to include any mark-ups from the approved shop drawing submittal.
    b. These drawings are to be adequately dimensioned and labeled to accurately locate components in the field according to the coordinated Sign-Off Model.
18. Installation
    a. Subcontractors shall be responsible for quality assurance that all components (materials and equipment) installed are being placed in the field in accordance with the Sign-Off Model, Approved Shop Drawings and construction tolerances.
    b. Subcontractors shall utilize established benchmarks (coordinated by field personnel) for the installation of all components.
    c. Laser scanning and/or surveying equipment may also be used as a quality control mechanism to validate installation conforms with the Sign-Off Model.

B. Subcontractor Model Requirements:
1. Subcontractor shall deliver a Model that is on-time, accurate, and representative of the actual elements that will be or are installed in the field.
2. Any elements not included in the Subcontractor Model will become the Subcontractor's responsibility to coordinate in the field at no additional cost to Life Time, the Owner, or other subcontractors affected by the inaccurate or incomplete information.
3. File Formats. Subcontractor shall provide Life Time with a Model in a format acceptable to Navisworks®. Life Time would also prefer to receive a DWG when possible, however all file types mentioned in the following table are acceptable.
    a. Additional file formats to be approved by Life Time.

Format	**Extension**
Navisworks	.nwd .nwf .nwc

AutoCAD	.dwg .dxf
Revit	.rvt (An .nwc must be accompanied by the Revit file)
IFC	.ifc
Inventor	.ipf .iam .ipi

4. Model Origin:
   a. Subcontractor shall model their scope Model Elements on the base coordinate system set by Life Time in the provided Architectural/Structural Base Construction Model.
5. Object Enablers:
   a. Subcontractor shall provide download location of all Object Enablers (OE) required for custom objects to be displayed correctly outside of the Subcontractor's authoring application software.
6. Model Extent Requirements:
   a. The Model Elements provided by the Subcontractor shall extend to five feet beyond the exterior walls of the building, unless the specific Scope of Work (i.e., Civil, Landscape, Irrigation, etc.) to be modeled is intended to be outside the building footprint.
   b. Vertically, the Model Elements shall extend from the lowest extent of the foundations up through (and including) the roof of the upper most floor. To the extent that the Scope of Work includes building systems, those systems will be included to the full horizontal and vertical extents of the model including all systems in the soffits and roof-top mounted items.
7. Level of Detail:
   a. The Subcontractor's Model Elements shall include, at a minimum: all systems and components modeled to a Level of Detail consistent with objects represented by a 1/8" plan/elevation/section drawing. See Requirements for specific scopes of work below.
8. Model Clarity:
   a. The Subcontractor's Model shall be organized so that Model Elements can be clearly identified by name and/or layer by the Project Team and Owner.
   b. Subcontractor shall provide Life Time with their standard Model Element naming conventions and layer structure at Kick-Off meeting for approval.

C. Model Element Scope:
1. Model Element Scope. The following sections define the specific Model Element Scope for each Scope of Work. The Model Elements defined below are the minimum requirements; Subcontractor shall incorporate Model Elements beyond the scope below if they deem it necessary for proper coordination.
2. HVAC Scope of work: Specific dimensional locations of HVAC/Mechanical Systems may not be included in the Construction Documents; to the extent that location can be determined from the Construction Documents, the Model Elements are to reflect that location.
   a. Duct and Associated Equipment. All ducts, including joints and hangers, smoke dampers, fire dampers, diffusers, registers, grilles, air handling equipment, etc. are to be included. Ducts shall be modeled to the outside face dimension; support mechanisms shall be modeled. Flexible systems smaller than 1" are not required to be modeled; however, it is encouraged.
   b. Mechanical Equipment. Equipment shall be modeled to its overall height, width, and depth. All support mechanisms shall be modeled.
   c. Piping. All piping, such as condensate, associated with the mechanical equipment shall be modeled and should include fittings and connections, insulation, and support mechanisms. Piping smaller than 1" that does not require gravity slope may be excluded from the model. All valves and clean-outs shall be modeled and specially identified to allow them to be readily found.
   d. Electrical Requirements. Any electrical associated with HVAC shall be modeled to the line side of disconnect.
   e. Maintenance / Clearance Access. Maintenance access areas and all other code required clearance areas associated with Model Elements shall be modeled

1) Include all access doors in walls and ceilings.
2) The access/code required clearance areas shall be modeled to the full extent of the access location (ex. VAV access zones shall be modeled to the ceiling/floor below to ensure clear and free access).
3) Access elements shall be clearly identified in the Model and assigned a unique CAD layer or object material.

f. Penetrations / Sleeves. Sleeves shall be modeled if penetrations through building systems such as cast-in-place concrete and CMU walls require a sleeve per the Specifications.

3. Plumbing Scope of Work: Specific dimensional locations of Plumbing Systems may not be included in the Construction Documents; to the extent that location can be determined from the Construction Documents, the Model Elements are to reflect that location.
   a. Piping. All plumbing piping requiring gravity slope as well as all specialty piping (i.e., medical gas) shall be modeled to the outside diameter of the pipe with any pipe insulation (on a separate CAD Layer/Model Object) clearly defined and should include fittings, connections, hangers, and slope. Piping smaller than 1” (not including insulation) that does not require gravity slope may be excluded from the model, however modeling such pipes is encouraged to reserve space. All valves and clean-outs shall be modeled and specially identified to allow them to be readily found.
   b. Plumbing Equipment. All plumbing equipment shall be modeled to its overall height, width, and depth. All support mechanisms shall be modeled.
   c. Maintenance / Clearance Access. Maintenance access areas and all other code required clearance areas associated with Model Elements shall be modeled.
      1) Include all access doors in walls and ceilings. Access elements are to be clearly identified in the Model and are to be assigned a unique CAD layer or object material.
   d. Penetrations / Sleeves. Sleeves shall be modeled if penetrations through building systems such as cast-in-place concrete and CMU walls require a sleeve per the Specifications.
   e. Gravity Slope Requirements. Plumbing systems requiring gravity sloping are to be identified with object parameters or placed on separate layers.
4. Electrical Scope of Work: Specific dimensional locations of Electrical Systems may not be included in the Construction Documents; to the extent that location can be determined from the Construction Documents, the Model Elements are to reflect that location.
   a. Equipment. All Electrical Equipment shall be modeled to its overall height, width, and depth.
      1) Include switch gears, transformers, generators, panels, etc. All support mechanisms are to be modeled. All power feeds to equipment will be modeled.
      2) All support mechanisms shall be modeled.
      3) All power feeds to equipment shall be modeled.
   b. Cable Tray and Conduit. All Cable tray and gangs of conduit shall be modeled as well as individual conduits 1” or larger.
      1) Electrician will be responsible for modeling all electrical associated with HVAC from the point the Mechanical Subcontractor stops (line side of disconnect).
      2) Flexible systems smaller than 1” are not required to be modeled.
5. Fire Protection Scope of Work:
   a. Equipment. All equipment, such as fire pumps, associated with the Fire Protection system shall be modeled.
   b. Piping. All Fire Protection piping, including fittings, connections, slopes, valves, and sprinkler heads shall be modeled.
      1) Support mechanisms shall be modeled.
      2) Include Temporary standpipe
   c. Maintenance / Clearance Access. Maintenance access areas and all other code required clearance areas associated with Model Elements shall be modeled;
      1) Include all access doors in walls and ceilings.
      2) Access elements shall be clearly identified in the Model and assigned a unique CAD layer or object material.

d. Penetrations / Sleeves. Sleeves are to be modeled if penetrations through building systems such as cast-in-place concrete and CMU walls require a sleeve per the Specifications.

6. Steel Scope of Work:
   a. The structural steel fabricator shall model their Scope of Work, including all structural and miscellaneous steel in detail.
      1) Include columns, beams, bolted connections, gusset plates, stairs, equipment supports, embeds, and other miscellaneous supports.
7. Food Service Scope of Work:
   a. The food service equipment provider shall model their Scope of Work.
      1) Include all equipment, with locations of necessary electrical/gas/ventilation hook ups.
      2) Include furniture, worktops, clear space, etc.

1.07 SUBMITTALS

A. Coordination Submissions.
   1. Subcontractor is to issue their current Model by the scheduled submission deadlines as spelled out in the 3D Coordination Kick-off Meeting and as otherwise required by the Project Schedule or Life Time.
   2. The Subcontractor's model shall conform to the established coordinate system and units.
   3. The Subcontractor shall issue their models per the defined naming convention.
   4. Life Time will combine all Subcontractor Models with the Construction Base Model to create the Coordination Model(s).

B. Shop Drawing Submittals of affected Scopes of Work.
   1. Shop Drawing submittals to the engineer/architect shall be provided as required by the specifications and are to be based on the approved Sign-Off Model.
      a. These submittals are to be issued following the completion and sign-off of the Coordination Model for the designated area. In some instances, the coordinated Subcontractor Model may also be requested by the Design team for review.

PART 2 PRODUCTS

2.01 NOT USED

PART 3 EXECUTION

3.01 NOT USED

ATTACHMENTS

ATTACHMENT A: 3D COORDINATION SIGN-OFF

END OF SECTION

Attachment A

3D Coordination Sign-Off
Area(s) Being Finalized: _____

Statement of Coordination Completion:
Life Time and the Subcontractors listed below confirm that the Navisworks model dated_____for the area(s) being finalized of the Project noted above has been satisfactorily coordinated between all trades of the MEP systems and the Architectural & Structural elements. The design elements of this model are based on the current Construction Documents dated_____.

Subcontractor agrees to prepare field drawings and install their respective components per the coordinated model. Any variations and/or conflicts in the field between coordinated elements will be reviewed by Life Time to determine fault. Components that are confirmed to be installed in conflict with the coordinated model layout and create obstacles or additional work for other disciplines shall require one of the following actions: a) removal and reinstallation per model, or b) monetary compensation to the affected party.

Changes occurring to the Construction Documents following sign-off will be treated on a case-by-case basis, but typically changes will be the responsibility of Subcontractor to coordinate with the signed-off model. Any changes made by Subcontractor should be reflected in their next Model submitted to Life Time. When necessary, Life Time will request revised models in order to coordinate the changes prior to install.

Contractor -

Signature: _____ Date: _____

Name / Title: _____

HVAC, Plumbing, Mechanical Subcontractor

Company Name: _____

Project Manager Signature: _____ Date: _____

Project Manager Name: _____

Foreman Signature: _____ Date: _____

Foreman Name: _____

Initial_____

Electrical Subcontractor

Company Name: _____

Project Manager Signature: _____ Date: _____

Project Manager Name: _____

Foreman Signature: _____ Date: _____

Foreman Name: _____

Fire Protection Subcontractor

Company Name: _____

Project Manager Signature: _____ Date: _____

Project Manager Name: _____

Foreman Signature: _____ Date: _____

Foreman Name: _____

Steel Subcontractor

Company Name: _____

Project Manager Signature: _____ Date: _____

Project Manager Name: _____

Foreman Signature: _____ Date: _____

Foreman Name: _____

Glazing Subcontractor

Company Name: _____

Project Manager Signature: _____ Date: _____

Project Manager Name: _____

Foreman Signature: _____ Date: _____

Foreman Name: _____

Initial_____

Other Subcontractor

Company Name: _____

Project Manager Signature: _____ Date: _____

Project Manager Name: _____

Foreman Signature: _____ Date: _____

Foreman Name: _____

Other Subcontractor

Company Name: _____

Project Manager Signature: _____ Date: _____

Project Manager Name: _____

Foreman Signature: _____ Date: _____

Foreman Name: _____

Other Subcontractor

Company Name: _____

Project Manager Signature: _____ Date: _____

Project Manager Name: _____

Foreman Signature: _____ Date: _____

Foreman Name: _____

Other Subcontractor

Company Name: _____

Project Manager Signature: _____ Date: _____

Project Manager Name: _____

Foreman Signature: _____ Date: _____

Foreman Name: _____

Initial_____

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SECTION 01 33 00
SUBMITTAL PROCEDURES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

1.02 RELATED SECTIONS:

A. Section 01 11 00 - Summary of Work for submitting schedules and reports, including Contractor's construction schedule.

B. Section 01 40 00 - Quality Requirements for informational submittals related to testing of materials.

C. Section 01 43 39 - Mockups, for requirements of mockups.

D. Section 01 60 00 - Product Requirements for product requirements for submittals.

E. Section 01 92 00 - Facility Operation and Maintenance.

F. All Divisions 2-33 for individual submittal requirements.

G. Applicable conditions of the General Contractor Subcontract.

1.03 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Architect's and General Contractor's responsive action.

B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's and General Contractor's responsive action. Submittals may be rejected for not complying with requirements.

1.04 ACTION SUBMITTALS

A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or modifications to submittals noted by the Architect and General Contractor and additional time for handling and reviewing submittals required by those corrections.

1.05 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
   1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
   2. Coordinate transmittal of different types of submittals for related parts of the Work so processing is not delayed because of need to review submittals concurrently for coordination.
      a. Architect and General Contractor reserve the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

B. Processing Time: Allow time for submittal review, including time for re-submittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Subcontract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including re-submittals.
   1. Submittal Review: Allow 5-10 business days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise General Contractor when a submittal being processed must be delayed for coordination.
   2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
   3. Re-submittal Review: Allow 5-10 business days for each resubmittal.

C. Identification and Information: Place a permanent label or title block on each paper copy submittal item for identification.

1. Indicate name of firm or entity that prepared each submittal on label or title block.
2. Provide a space approximately 4 by 5 inches on label or beside title block to record Subcontractor's review and approval markings and action taken by Architect.
3. Include the following information for processing and recording action taken:
    a. Project name.
    b. Name of subcontractor.
    c. Name of supplier.
    d. Name of manufacturer.
    e. Submittal number or other unique identifier, including revision identifier.
    f. Number and title of appropriate Specification Section.
    g. Drawing number and detail references, as appropriate.
    h. Location(s) where product is to be installed, as appropriate.
    i. Other necessary identification.

D. Transmittal: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will return submittals, without review, received from sources other than General Contractor.
1. Transmittal Form: Include Transmittal Form with Company Letterhead.
2. On an attached separate sheet, prepared on Subcontractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.

E. Re-submittals: Make resubmittals in same form and number of copies as initial submittal.
1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block and clearly indicate extent of revision.
3. Resubmittals, if necessary, shall cloud and clearly identify revisions from previous submittals.
4. Resubmit submittals until they are marked with approval notation from General Contractor’s and Architect’s action stamp.

F. Use for Construction: Use only final submittals that are marked with approval notation from General Contractor’s and Architect’s action stamp.

G. Use **CSI Form 13.1 for “Substitution Requests”**. See Section 01 60 00 – Product Requirements for product substitution and comparable product requirements.

PART 2 PRODUCTS

2.01 SUBMITTAL PROCEDURES

A. General Submittal Procedure Requirements:
1. Submit electronically via Procore website.
    a. General Contractor will assign each subcontractor a site username and password once contract documents have been executed. An email will be sent to the subcontractor with information and directions for the site access.
    b. Physical samples must be delivered to General Contractor for any submittal showing kind, color, textures and/or patterns for the architect to approve. A picture of physical sample is to be included with electronic submittal package, for record and mark-up purposes.
2. Action Submittals: Submit electronically via Procore website. Submittals shall be returned via the same website.
3. Informational Submittals: Submit electronically via Procore website. Submittals shall be returned via the same website, if applicable.
4. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Division 1 Section 01 77 00 "Closeout Procedures."
5. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
    a. Provide a digital signature with digital certificate on electronically-submitted certificates and certifications where indicated.
    b. Provide a notarized statement on original paper copy certificates and certifications where

indicated.

6. Test and Inspection Reports Submittals: Comply with requirements specified in Division 1 Section 01 40 00 "Quality Requirements."

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
   1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
   2. Mark submittal to show which products and options are applicable.
   3. Include the following information, as applicable:
      a. Manufacturer's catalog cuts.
      b. Manufacturer's product specifications.
      c. Standard color charts.
      d. Statement of compliance with specified referenced standards.
      e. Testing by recognized testing agency.
      f. Application of testing agency labels and seals.
      g. Notation of coordination requirements.
      h. Availability and delivery time information.
   4. For equipment, include the following in addition to the above, as applicable:
      a. Wiring diagrams showing factory-installed wiring.
      b. Printed performance curves.
      c. Operational range diagrams.
      d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
   5. Submit Product Data before or concurrent with Samples.
   6. Submit Product Data via website provided by Owner’s Representative, in PDF format.

C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
   1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
      a. Identification of products.
      b. Schedules.
      c. Compliance with specified standards.
      d. Notation of coordination requirements.
      e. Notation of dimensions established by field measurement.
      f. Relationship and attachment to adjoining construction clearly indicated.
      g. Seal and signature of professional engineer if specified.
   2. Format: Provide shop drawings in the following format, if applicable:
      a. Cover Sheet with ample room for approval/review stamp.
      b. Shop Drawing Index, if multiple sections or submittals are being submitted.
      c. Bind all PDF sheets into one file.
         1) PDF files shall be bookmarked and searchable.
      d. Cloud deviations from construction documents.
      e. Cloud changes on re-submittals.
   3. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches but no larger than 24 by 36 inches.
   4. Submit Shop Drawings via website provided by Owner’s Representative, in PDF format.

D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
   1. **Sample Submittals may be waived for interior finishes if the specified material is supplied without variation, at the discretion of the Architect.**
   2. Transmit Samples that contain multiple, related components such as accessories together in one submittal package. Include a photo record within electronic submittal package, uploaded to

website provided by Owner’s Representative.

3. Identification: Attach label on unexposed side of Samples that includes the following:
   a. Generic description of Sample.
   b. Product name and name of manufacturer.
   c. Sample source.
   d. Number and title of applicable Specification Section.
      1) If multiple materials are specified in one Specification Section, identify each sample according to the specified material name or code.
4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
   a. Number of Samples: Submit 1 full set of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
   a. If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least 3 of paired units that show approximate limits of variations.

E. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
   1. Submit product schedule via website provided by Owner’s Representative, in PDF format.

F. Contractor's Construction Schedule: Comply with requirements specified in Division 1 Section 01 11 00 "Summary of Work."

G. Application for Payment: Comply with requirements specified in Division 0 Section 00 52 00 – Agreement Forms and Division 0 Section 00 72 00 – General Conditions.

H. Schedule of Values: Comply with requirements specified in Division 1 Section "Payment Procedures."

I. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design.
   1. Submit subcontract list via website provided by Owner’s Representative, in PDF format.

J. Coordination Drawings: Comply with requirements specified in Division 1 Section 01 31 00 "Project Management and Coordination."

K. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.

L. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on American Welding Society (AWS) forms. Include names of firms and personnel certified.

M. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

N. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

O. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

P. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

Q. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

R. Product Test Reports: Submit written reports indicating current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

S. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project.

T. Schedule of Tests and Inspections: Comply with requirements specified in Division 1 Section 01 40 00 "Quality Requirements."

U. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

V. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

W. Field Test Reports: Submit reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

X. Maintenance Data: Comply with requirements specified in Division 1 Section 01 92 00 "Operation and Maintenance Data."

Y. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

Z. Quantity Take-offs: Submit quantity take-offs for all indicated materials. Include area and quantity of all materials for coordination of product procurement with Owner. See Section 01 64 00.

AA. Procurement Submittals:

1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment and delivery schedule.
2. Submit inventory of materials within 5 days of receipt.
3. If material is to be stored off-site, include address, proof of lease, proof of insurance and photographs of stored material.

202 DELEGATED-DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Subcontractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to the Architect.

B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally-signed PDF electronic file and 3 paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Subcontractor to be designed or certified by a design professional.
   1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

PART 3 EXECUTION

3.01 SUBCONTRACTOR'S REVIEW

A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to the Architect.

B. Project Closeout and Maintenance/Material Submittals: Refer to requirements in Division 1 Section 01 77 00 "Closeout Procedures."

C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Subcontractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.02 ARCHITECT’S ACTION

A. General: The Architect will not review submittals that do not bear General Contractor’s and Subcontractor's approval stamp and will return them without action.

B. Action Submittals: The Architect will review each submittal, make marks to indicate corrections or modifications required, and return it. The Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.

C. Informational Submittals: The Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. The Architect will forward each submittal to appropriate party.

D. Incomplete submittals are not acceptable, will be considered nonresponsive, and will be returned without review.

E. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

ATTACHMENTS

4.01 SAMPLE SUBMITTAL LOG

A. See attached for sample Submittal Log.

B. Contractor is responsible for preparing a Submittal Log to be used during the process of Construction.

   1. Provide Submittal log to Architect prior to submittals.
   2. Submittal Log is to include estimated dates of submittal and required review dates of submittals.

END OF SECTION

Section #	Section Name	Shop Drawings	Signed & Sealed	Samples for Verification	Samples for color selection	Manufactuer's Installation Instructions	Product Data	Mix Design	Calculations	Qualification Data	Test Data/Reports	Research / Evaluation Reports	Certificates	QA/QC Submittals	Operations & Maintenance	Warranty	Quantity Take-offs	Procurement	Other (See Notes)	Notes	ARCH	ID	CODE SPEC.	STRUCT	MECH	ELEC	AQ	CIV	LA ARCH	LT OPS	LT OPS (Cx)	LT IT/AV
02 - EXISTING CONDITIONS																																
02 41 13	Selective Site Demolition									Yes								Yes	Yes	Proposed Protection and Control Measures	x			x				x				
																				Schedule of Building Demolition Activities	x			x				x				
																				Pre-demolition Photographs	x			x				x				
																				Landfill Records								x				
																				Statement of Refrigerant Recovery								x				
03 - CONCRETE																																
03 20 00	Concrete Reinforcement	Yes																Yes						x								
03 30 00	Cast-In-Place Concrete	Yes						Yes			Yes			Yes				Yes	Yes	Certification of Compliance	x			x								
																				Proprietary Material & Items				x								
																				Material & Equipment				x								
03 38 00	Post-Tensioned Concrete	Yes	Yes					Yes			Yes			Yes				Yes	Yes	Material & Equipment	x			x								
03 41 00	Precast Structural Concrete	Yes	Yes	Yes		Yes	Yes	Yes		Yes	Yes			Yes				Yes	Yes	Erection Plan	x			x	x	x						
																				Welding Certificates				x								
																				Certification of Compliance				x								
03 45 00	Precast Architectural Concrete	Yes		Yes		Yes		Yes										Yes			x			x								
03 45 70	Architectural Site-Cast Concrete Wall Panels	Yes						Yes	Yes	Yes								Yes			x			x	x	x						
04 - MASONRY																																
04 20 00	Unit Masonry			Yes			Yes	Yes					Yes					Yes			x			x								
04 72 00	Architectural Cast Stone	Yes		Yes							Yes		Yes			Yes		Yes			x											
05 - METALS																																
05 12 00	Structural Steel	Yes	Yes				Yes		Yes	Yes	Yes		Yes					Yes	Yes	Welding Certificates	x			x	x							
05 12 19	Buckling-Restrained Braces	Yes	Yes						Yes		Yes	Yes	Yes					Yes	Yes	Quality Assurance Plan,Inspection report	x			x								
05 21 00	Steel Joist Framing	Yes	Yes				Yes		Yes	Yes		Yes	Yes	Yes				Yes	Yes	Welding Certificates	x			x								
05 31 00	Steel Decking	Yes					Yes				Yes	Yes	Yes	Yes				Yes	Yes	Welding Certificates	x			x	x							
05 40 00	Cold-Formed Metal Framing	Yes	Yes				Yes		Yes	Yes	Yes	Yes						Yes	Yes	Welding Certificates	x			x								
05 50 00	Metal Fabrications	Yes		Yes						Yes			Yes					Yes	Yes	Welding Certificates	x			x								
05 51 00	Metal Stairs	Yes	Yes				Yes		Yes									Yes			x			x								
05 70 00	Decorative Metal	Yes					Yes											Yes			x	x										
05 73 13	Glazed Decorative Metal Railings	Yes		Yes			Yes				Yes							Yes			x	x		x								
05 73 16	Wire Rope Decorative Metal Railings	Yes		Yes			Yes			Yes	Yes	Yes						Yes			x	x		x								
05 77 30	Smoke Baffle System	Yes		Yes			Yes				Yes			Yes	Yes	Yes		Yes			x											
06 - WOODS AND PLASTICS																																
06 10 00	Rough Carpentry						Yes					Yes						Yes			x											
06 15 00	Wood Decking			Yes			Yes											Yes	Yes	LEED Submittals	x											
06 16 13	Structural Insulating Sheathing	Yes				Yes	Yes									Yes		Yes			x			x								
06 20 00	Finish Carpentry			Yes			Yes					Yes				Yes		Yes			x	x										
06 40 00	Architectural Woodwork	Yes		Yes			Yes						Yes					Yes			x	x										
06 64 00	Plastic Paneling			Yes			Yes											Yes			x	x										
07 - THERMAL AND MOISTURE PROTECTION																																
07 13 26	Pre-Applied Sheet Membrane Waterproofing	Yes		Yes		Yes	Yes									Yes		Yes	Yes	Repair Details	x											
07 14 00	Hot-Applied Membrane Waterproofing			Yes			Yes				Yes		Yes			Yes		Yes	Yes	Manufacturer's certificate that material is appropriate for project.												
																		Yes		On Site Adhesion Test	x											
07 14 50	Fluid-Applied Waterproofing Membrane			Yes			Yes				Yes					Yes		Yes	Yes	Site Visit Report	x											
07 18 00	Traffic Coatings					Yes	Yes			Yes					Yes	Yes		Yes			x											
07 21 00	Thermal Insulation			Yes		Yes	Yes											Yes			x											
07 24 19	Water-Drainage Exterior Insulation and Finish System	Yes		Yes			Yes				Yes	Yes	Yes	Yes	Yes			Yes			x											
07 24 20	Polymer-Based Interior Finish System (IFS)			Yes			Yes			Yes	Yes				Yes			Yes			x											
07 27 01	High Performance Vapor Retarder			Yes		Yes	Yes			Yes								Yes	Yes	Storage	x											
07 27 26	Fluid-Applied Membrane Air Barriers	Yes					Yes											Yes			x											
07 27 27	Fluid-Applied Vapor Impermeable Air Barrier	Yes					Yes											Yes			x											
07 41 13	Metal Roof Panels	Yes		Yes			Yes											Yes			x											
07 42 00	Metal Wall Panels	Yes		Yes			Yes							Yes				Yes	Yes	Coordination Drawings	x											
07 42 63	Fabricated Wall Panel Assemblies	Yes		Yes			Yes			Yes	Yes				Yes	Yes		Yes			x			x	x	x						
07 46 33	Phenolic Wall Siding	Yes			Yes		Yes								Yes			Yes	Yes	Panel Color selection	x											
																		Yes		Code Compliance Documents												
07 53 23	Ethylene-Propylene-Diene-Monomer (EPDM) Roofing	Yes		Yes		Yes	Yes						Yes			Yes		Yes	Yes	Pre-Installation Meeting Minutes	x											
																		Yes		Material & Equipment	x											
07 54 23	Thermoplastic polyolefin (TPO) Roofing	Yes		Yes		Yes	Yes						Yes			Yes		Yes	Yes	Pre-Installation Meeting Minutes	x											
																		Yes		Material & Equipment	x											
07 62 00	Sheet Metal Flashing and Trim	Yes			Yes											Yes		Yes		Samples for Color Selection	x											
07 71 23	Manufactured Gutters and Downspouts	Yes		Yes			Yes			Yes								Yes			x											
07 72 33	Roof Hatches	Yes					Yes											Yes			x											
07 81 00	Applied Fireproofing	Yes					Yes			Yes	Yes	Yes	Yes					Yes			x											
07 81 60	Intumescent Fireproofing			Yes			Yes						Yes					Yes			x											
07 84 00	Firestopping						Yes			Yes	Yes		Yes					Yes	Yes	Product Schedule	x											
07 92 00	Joint Sealants				Yes		Yes			Yes	Yes		Yes			Yes		Yes	Yes	Color selection	x	x										
																		Yes		Joint Sealant Schedule	x					x						
07 95 00	Preformed Traffic Durable Sealant Systems	Yes		Yes	Yes		Yes						Yes					Yes		Color selection	x	x		x								
08 - OPENINGS																																
08 11 13	Hollow Metal Doors and Frames	Yes					Yes											Yes			x	x										
08 11 16	Aluminum Doors and Frames	Yes		Yes						Yes	Yes					Yes		Yes			x	x										
08 14 16	Flush Wood Doors	Yes		Yes			Yes									Yes		Yes			x	x										
08 31 13	Access Doors and Frames	Yes					Yes											Yes	Yes	Access Door & Frame Schedule	x	x										
08 33 23	Overhead Coiling Doors	Yes		Yes			Yes								Yes			Yes			x	x										
08 34 73.13	Metal Sound Control Doors	Yes				Yes	Yes					Yes						Yes			x											
08 34 83	Elevator Door Smoke Containment System	Yes				Yes	Yes		Yes	Yes			Yes		Yes	Yes		Yes			x				x							
08 36 16	Single Panel Doors	Yes					Yes								Yes			Yes			x					x						
08 38 00	Traffic Doors	Yes		Yes		Yes	Yes											Yes			x	x										
08 41 13	Aluminum Framed Entrances and Storefronts	Yes		Yes	Yes		Yes			Yes	Yes				Yes	Yes		Yes	Yes	Entrance Door Hardware Schedule. Sealant Color Selection	x	x										
08 42 45	Sliding Aluminum Doors	Yes		Yes		Yes	Yes									Yes		Yes			x	x										
08 43 13	Fire Rated Aluminum Framed Entrances and Storefronts	Yes		Yes			Yes		Yes	Yes			Yes	Yes	Yes	Yes		Yes	Yes	Hardware Schedule	x	x										
																		Yes		Glazing Schedule	x	x										
08 44 13	Glazed Aluminum Curtainwalls	Yes		Yes		Yes	Yes		Yes							Yes		Yes			x	x										
08 56 19	Pass Windows	Yes					Yes											Yes			x											
08 71 00	Door Hardware	Yes		Yes			Yes			Yes	Yes		Yes		Yes	Yes		Yes	Yes	Keying Schedule	x		x								x	
																		Yes		Door Hardware Sets	x	x									x	
08 81 00	Glazing			Yes			Yes						Yes			Yes		Yes			x	x										
08 87 13	Solar Control Film	Yes		Yes		Yes	Yes				Yes					Yes		Yes			x											
08 88 13	Fire Resistant Glazing			Yes			Yes						Yes					Yes	Yes	Product Test Listings	x											
09 - FINISHES																																
09 21 16	Gypsum Board Assemblies	Yes					Yes			Yes								Yes			x											
09 21 17	Gypsum Board Shaft Wall Assemblies						Yes											Yes			x											
09 21 16	Gypsum Fiber Reinforced Gypsum Fabrications	Yes					Yes			Yes								Yes			x											
09 30 00	Tiling			Yes			Yes										Yes	Yes			x	x										
09 48 30	Acoustical Treatments			Yes	Yes	Yes	Yes				Yes				Yes			Yes	Yes	MSDS and extra stock	x	x										
09 51 13	Acoustical Panel Ceilings			Yes			Yes					Yes			Yes		Yes	Yes			x	x										
09 54 23	Linear Metal Ceilings			Yes			Yes					Yes			Yes		Yes	Yes			x	x										
09 64 00	Wood Flooring			Yes			Yes								Yes			Yes			x	x										
09 64 66	Wood Athletic Flooring			Yes			Yes											Yes			x	x										
09 65 19	Resilient Tile Flooring			Yes	Yes		Yes								Yes		Yes	Yes		Transition and Nosing color selections.	x	x										
09 65 66	Resilient Athletic Sports Surface	Yes			Yes		Yes							Yes	Yes	Yes		Yes		Color Selection	x	x										
09 67 23	Resinous Flooring			Yes			Yes						Yes		Yes			Yes	Yes	Project Schedule	x	x										
09 68 13	Tile Carpeting			Yes			Yes			Yes	Yes					Yes	Yes	Yes	Yes	Project Schedule	x	x										
09 72 00	Wall Covering			Yes			Yes				Yes				Yes			Yes			x	x										
09 74 16	Flexible Wood Veneer Wall Covering			Yes		Yes	Yes								Yes			Yes			x	x										
09 75 00	Interior Stone	Yes		Yes			Yes				Yes				Yes			Yes			x	x										
09 77 26	Surfacing Films	Yes		Yes		Yes	Yes											Yes			x	x										
09 77 50	Vertical Surfacing Panel System			Yes		Yes	Yes								Yes		Yes	Yes	Yes	MSDS	x	x										
09 84 14	Acoustic Stretched-Fabric Wall Systems	Yes		Yes			Yes						Yes					Yes			x	x										
09 84 30	Sound Absorbing Wall and Ceiling Units	Yes		Yes	Yes		Yes			Yes								Yes	Yes	Fabric, color, pattern selection. Extra panels	x	x										
09 91 00	Painting			Yes			Yes											Yes	Yes	Product List	x	x										

Section #	Section Name	Shop Drawings	Signed & Sealed	Samples for Verification	Samples for color selection	Manufactuer's Installation Instructions	Product Data	Mix Design	Calculations	Qualification Data	Test Data/Reports	Research / Evaluation Reports	Certificates	QA/QC Submittals	Operations & Maintenance	Warranty	Quantity Take-offs	Procurement	Other (See Notes)	Notes	ARCH	ID	CODE SPEC.	STRUCT	MECH	ELEC	AQ	CIV	LA ARCH	LT OPS	LT OPS (Cx)	LT IT/AV
10 - SPECIALTIES																															
10 14 00	Signage	Yes		Yes			Yes											Yes	Yes	Signage Schedule	x	x	x									
																				Wiring Diagrams	x											
10 21 13.16	Plastic-Laminate-Clad Toilet Compartments	Yes					Yes									Yes		Yes	Yes	Product Specification Sheet	x	x										
10 22 36	Coiled Wire Fabric Attachment Systems	Yes		Yes			Yes		Yes				Yes					Yes			x	x										
10 22 38.13	Sliding and Stacking Glass Door Systems	Yes			Yes	Yes	Yes		Yes						Yes			Yes		Finish selection	x	x										
10 23 26	Glass Partition Systems	Yes		Yes		Yes	Yes								Yes	Yes		Yes			x	x										
10 28 13	Toilet and Bath Accessories						Yes											Yes	Yes	Project Schedule	x	x										
10 28 19	Glass Shower Doors	Yes		Yes			Yes								Yes			Yes			x	x										
10 31 00	Manufactured Fireplaces						Yes						Yes			Yes		Yes			x	x			x	x						
10 44 00	Fire Protection Specialties	Yes		Yes			Yes								Yes			Yes			x											
10 73 13	Metal Canopies	Yes		Yes					Yes	Yes			Yes					Yes	Yes	Delegated Design	x			x								
10 82 13	Exterior Equipment Screens	Yes		Yes			Yes		Yes				Yes			Yes		Yes			x				x							
11 - EQUIPMENT																																
11 21 73	Commercial Laundry Equipment						Yes											Yes			x				x	x				x		
11 40 00	Food Service Equipment	Yes					Yes				Yes				Yes			Yes	Yes	Wiring Diagrams	x				x	x						
																		Yes		Project Record Documents	x											
11 66 00	Athletic Equipment	Yes					Yes								Yes			Yes			x	x										
11 66 43	Scoreboards, Timers and Clocks	Yes		Yes			Yes							Yes	Yes	Yes		Yes		Project Record Documents	x											
12 - FURNISHINGS																																
12 56 90	Spa Furniture			Yes			Yes								Yes			Yes			x	x			x	x						
12 92 00	Artificial Plants	Yes		Yes		Yes	Yes								Yes			Yes														
13 - SPECIAL CONSTRUCTION																																
13 11 13	Swimming Pools - General	Yes	Yes					Yes			Yes				Yes	Yes		Yes	Yes	Record Drawings	x			x			x					
																		Yes		Owner Training Video												
13 11 15	Swimming Pool Finishes			Yes		Yes	Yes						Yes			Yes		Yes			x	x					x					
13 11 16	Swimming Pool Piping & Valves						Yes											Yes							x		x			x		
13 11 30	Prefabricated Swimming Pools	Yes		Yes						Yes						Yes		Yes			x			x			x					
13 11 46	Swimming Pool Equipment & Accessories					Yes	Yes						Yes					Yes		NSF 50 Certification Data	x		x				x					
13 14 13	Water Slides	Yes	Yes	Yes			Yes				Yes							Yes	Yes	Insurance Certificates	x	x			x		x					
13 24 16	Saunas	Yes		Yes			Yes								Yes	Yes		Yes			x	x										
13 34 19	Prefabricated Metal and Fabric Buildings	Yes	Yes	Yes			Yes		Yes				Yes			Yes		Yes			x	x										
13 48 13	Manufactured Sound and Vibration Control Components	Yes		Yes		Yes	Yes						Yes			Yes		Yes			x			x								
14 - CONVEYING EQUIPMENT																																
14 21 50	MRL Electric Traction Passenger Elevators	Yes		Yes			Yes			Yes			Yes		Yes	Yes		Yes	Yes	Continuing Maintenance Proposal	x	x									x	
14 24 00	Hydraulic Elevators	Yes		Yes			Yes			Yes			Yes		Yes	Yes		Yes	Yes	Continuing Maintenance Proposal	x	x									x	
14 26 00	Limited Application Elevator	Yes		Yes			Yes											Yes			x										x	
14 42 16	Vertical Wheelchair Lifts	Yes		Yes			Yes											Yes			x										x	
21 - FIRE SUPRESSION																																
21 05 00	Common Work Results for Fire Suppression												Yes							Welding Certificates					x							
21 05 29	Hangers and Supports for Fire Suppression	Yes					Yes						Yes							Welding Certificates				x	x							
21 05 53	Identification for Fire Suppression						Yes																		x							
21 13 13	Wet-Pipe Fire Suppression	Yes	Yes				Yes		Yes	Yes	Yes		Yes	Yes	Yes				Yes	Welding Certificates					x							
																				Installer Qualifications					x							
22 - PLUMBING																																
22 05 00	Common Work Results for Plumbing												Yes							Welding Certificates					x							
22 05 19	Meters and Gauges for Plumbing						Yes																		x							
22 05 23	General-Duty Valves for Plumbing						Yes																		x							
22 05 29	Hangers and Supports for Plumbing	Yes					Yes						Yes							Welding Certificates					x							
22 05 53	Identification for Plumbing						Yes																		x							
22 07 00	Plumbing Insulation	Yes					Yes																		x							
22 11 16	Domestic Water Piping						Yes																		x							
22 11 19	Domestic Water Piping Specialties						Yes								Yes										x							
22 11 23	Domestic Water Pumps						Yes								Yes										x							
22 11 24	Domestic Water Booster Pumps	Yes					Yes								Yes										x							
22 11 25	Facility Natural-Gas Piping	Yes					Yes						Yes	Yes						Welding Certificates					x							
22 13 16	Sanitary Waste and Vent Piping						Yes																		x							
22 13 19	Sanitary Waste Piping Specialties						Yes								Yes						x	x			x							
22 14 16	Storm Drainage Piping						Yes																		x							
22 14 19	Storm Drainage Piping Specialties						Yes														x				x							
22 14 20	Subdrainage						Yes																		x							
22 14 29	Sump Pumps						Yes								Yes	Yes			Yes	Wiring Diagrams					x							
22 31 00	Water Softeners	Yes					Yes							Yes	Yes	Yes				Field Quality Control Test Reports					x							
22 33 00	Electric Water Heaters	Yes					Yes								Yes	Yes									x							
22 34 00	Gas-Fired Water Heaters	Yes					Yes								Yes	Yes									x							
22 35 00	Domestic Hot Water Heat Exchangers										Yes		Yes	Yes		Yes				Field Quality Control Reports					x							
																				Source Quality Control Reports					x							
22 40 00	Plumbing Fixtures	Yes					Yes								Yes	Yes					x	x			x							
22 52 13	Steam Room Generators	Yes					Yes								Yes	Yes					x				x							
23 - HEATING, VENTILATING AND AIR CONDITIONING (HVAC)																																
23 05 00	Common Work Results for HVAC											Yes								Welding Certificates					x							
23 05 23	General-Duty Valves for HVAC						Yes																		x							
23 05 29	Hangers and Supports for HVAC	Yes					Yes					Yes								Welding Certificates				x	x							
23 05 53	Identification for HVAC						Yes																		x							
23 05 93	Testing, Adjusting, and Balancing																		Yes	Strategies and Procedures Plan					x							
																				Certified TAB Reports					x							
23 07 00	HVAC Insulation	Yes					Yes																		x							
23 09 00	HVAC Instrumentation and Controls	Yes					Yes							Yes	Yes	Yes			Yes	Field Quality Control Test Reports					x							
																				Wiring Diagrams					x							
23 09 90	Commissioning of HVAC																		Yes	Certificates of Readiness					x							
																				Certificates of completion of installation, prestart, and startup activities.					x							
23 09 95	Mechanical System Commissioning	Yes													Yes				Yes	Sequences of Operation Submittal					x							
																				Control Drawings Submittal					x							
23 21 13	Hydronic Piping						Yes							Yes	Yes					Field Quality Control Test Reports					x							
23 21 23	Hydronic Pumps	Yes					Yes								Yes										x							
23 31 13	Metal Ducts	Yes					Yes						Yes		Yes				Yes	Welding Certificates					x							
																				Delegated-Design Submittals					x							
23 31 16	Nonmetal Ducts	Yes					Yes								Yes										x							
23 33 00	Duct Accessories	Yes					Yes								Yes										x							
23 34 23	Power Ventilators	Yes					Yes							Yes	Yes					Field Quality Control Test Reports					x							
23 36 00	Air Terminal Units	Yes					Yes							Yes	Yes				Yes	Field Quality Control Test Reports					x							
																				Delegated-Design Submittals					x							
23 37 13	Diffusers, Registers, Grilles and Louvers						Yes																		x							
23 52 16	Condensing Boilers	Yes					Yes							Yes	Yes	Yes			Yes	Field Quality Control Test Reports					x							
																				Source Quality-Control Test Reports					x							
23 57 00	Hydronic Heat Exchangers						Yes																		x							
23 74 13	Packaged, Outdoor, Air-Handling Units	Yes					Yes							Yes	Yes	Yes				Field Quality Control Test Reports					x							
23 74 20	Make-Up Air Unit	Yes					Yes							Yes	Yes	Yes				Field Quality Control Test Reports					x							
23 74 23	Energy Recovery Units	Yes					Yes							Yes	Yes	Yes				Field Quality Control Test Reports					x							
23 81 26	Split-System Air-Conditioning Units						Yes								Yes						x				x							
23 82 39	Electric Heaters	Yes					Yes							Yes	Yes					Field Quality Control Test Reports					x							
25 - INTEGRATED AUTOMATION																																
25 10 00	Integrated Automation System - Network Systems	Yes					Yes			Yes					Yes				Yes	See Spec Section for more submittal requirements					x	x						
25 20 00	Integrated Automation System - Instrumentation																															
25 30 00	Integrated Automation System - Terminations																															
25 50 00	Variable Frequency Drives	Yes					Yes												Yes	See Spec Section for more submittal requirements					x	x						
25 90 00	Integrated Automation System - Sequence of Operations																															
25 50 00	Integrated Automation System - Master Points List																															

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26 - ELECTRICAL																															
26 05 19	Low-Voltage Electrical Power Conductors and Cables	Yes				Yes	Yes												Yes	Project Record Documents						x		x			x	
26 05 23	Control-Voltage Electrical Power Cables	Yes					Yes				Yes									Field Quality Control Test Reports						x					x	
26 05 26	Grounding and Bonding for Electrical Systems	Yes					Yes												Yes	Project Record Documents						x					x	
26 05 29	Hangers and Supports for Electrical Systems	Yes				Yes	Yes			Yes										Installer Qualifications						x					x	
26 05 34	Conduit for Electrical Systems	Yes					Yes												Yes	Project Record Documents						x					x	
26 05 36	Cable Trays for Electrical Systems	Yes				Yes	Yes												Yes	Project Record Documents						x					x	
																				Seismic Bracing (where applicable)						x						
26 05 37	Boxes for Electrical Systems	Yes					Yes																			x					x	
26 05 40	Underfloor Ducts	Yes				Yes	Yes								Yes				Yes	Project Record Documents	x			x		x					x	
																				Maintenance Materials						x						
26 05 48	Vibration and Seismic Controls for Electrical Systems		Yes				Yes		Yes		Yes		Yes							Delegated-Design Submittals (Signed and Sealed)				x		x					x	
																				Welding Certificates						x						
																				Field Quality Control Test Reports						x						
26 05 53	Identification for Electrical Systems	Yes					Yes																			x					x	
26 09 23	Digital Lighting Control System	Yes					Yes								Yes											x					x	
26 27 26	Wiring Devices	Yes					Yes								Yes				Yes	Project Record Documents						x						
																				Maintenance Materials						x					x	
26 29 01	Integrated Low Voltage Distribution & Controls	Yes					Yes								Yes											x					x	
26 51 00	Interior Lighting	Yes		Yes		Yes	Yes				Yes		Yes		Yes					Certificates for Dimming Ballasts	x	x				x					x	
																				Field Quality Control Test Reports						x						
26 56 00	Exterior Lighting	Yes		Yes		Yes	Yes						Yes		Yes				Yes	Sustainable Design Documentation	x					x					x	
																				Certificates for Poles and Accessories						x						
																				Project Record Documents						x						
27 - COMMUNICATIONS																															
27 11 00	Communications Equipment Room Fittings and Pathways	Yes					Yes																			x						x
27 12 00	Identification for Communications Systems	Yes		Yes																						x						x
27 13 50	Structured Cabling for Voice and Data						Yes			Yes	Yes								Yes	Installer Qualifications						x						x
																				Field Test Reports						x						x
																				Project Record Documents						x						x
27 20 00	Ambient Sound Distribution and Masking System	Yes					Yes																			x						x
27 25 00	Audio/Visual Systems and Displays	Yes					Yes																			x						x
27 41 33	Broadband Television Distribution System						Yes							Yes	Yes				Yes	Field Quality Control Test Reports						x						x
																				Project Record Documents						x						x
27 45 00	Video Surveillance						Yes		Yes						Yes	Yes			Yes	Video Storage Capacity Calculations						x						x
																				Project Record Documents						x						x
27 51 29	Area of Refuge Rescue assistance System	Yes					Yes		Yes										Yes	Standby Battery Calculations						x						x
																				Maintenance Contracts						x						x
28 - ELECTRONIC SAFETY AND SECURITY																															
28 31 11	Digital Addressable Fire Alarm System	Yes					Yes			Yes	Yes				Yes				Yes	Project Record Documents						x						
28 31 19	Distributed Antenna System	Yes					Yes								Yes				Yes	System Block Diagrams						x						x
																				Reports and Schedules						x						x
31 - EARTHWORK																															
31 10 00	Site Clearing																		Yes	Existing Conditions								x				
																				Record Drawings								x				
31 23 00	Excavation and Fill						Yes			Yes	Yes		Yes						Yes	Preexcavation Photos or Videos								x				
																				Delivery Slips								x				
31 23 19	Dewatering	Yes								Yes				Yes					Yes	Photographs								x				
31 63 29	Drilled Concrete Piers and Shafts	Yes					Yes	Yes																x				x			
32 - EXTERIOR IMPROVEMENTS																															
32 13 13	Concrete Paving	Yes					Yes	Yes		Yes			Yes					Yes			x											
32 14 00	Unit Paving			Yes			Yes											Yes	Yes	Sieve Analyses	x	x							x			
32 17 23	Pavement Marking						Yes											Yes			x											
32 18 23	Synthetic Field Sport Surfacing			Yes			Yes							Yes		Yes		Yes			x	x										
32 18 25	Athletic Surfacing	Yes		Yes			Yes							Yes				Yes			x	x										
32 31 13	Tennis, Pickleball Fences, Gates and Windscreens	Yes		Yes			Yes									Yes		Yes	Yes	Delegated Design Submittal	x											
32 31 15	Tennis, Pickleball Nets, Posts, Divider Nets and Backing Curtains	Yes					Yes							Yes				Yes			x												
32 31 19	Decorative Metal Fences and Gates	Yes		Yes			Yes								Yes			Yes	Yes	Delegated Design Submittal	x											
32 32 23	Segmented Retaining Walls	Yes	Yes	Yes					Yes				Yes					Yes			x			x				x	x		
32 33 00	Site Furnishings	Yes		Yes			Yes									Yes		Yes			x								x		
32 35 15	Landscape Shade Tops						Yes				Yes		Yes		Yes	Yes		Yes			x											
32 35 16	Outdoor Shade Structures	Yes	Yes	Yes			Yes								Yes	Yes		Yes			x											
32 84 00	Planting Irrigation	Yes					Yes			Yes					Yes			Yes	Yes	Wiring Diagrams	x							x	x			
																				Delegated Design Submittal	x							x	x			
																				Coordination Drawings	x							x	x			
																				Zoning Chart	x							x	x			
																				Controller Timing Schedule	x							x	x			
																				Field Quality Control Reports	x							x	x			
32 92 00	Turf and Grasses						Yes			Yes	Yes							Yes	Yes	Certification of Grass Seed								x	x			
																		Yes		Certification of Seed Mixtures								x	x			
32 93 00	Plants						Yes			Yes	Yes		Yes			Yes		Yes	Yes	Maintenance Instructions	x							x	x			
33 - UTILITIES																															
33 10 00	Water Utilities	Yes					Yes							Yes		Yes			Yes	Coordination Drawings								x				
33 30 00	Sanitary Sewerage Utilities	Yes											Yes	Yes												x		x				
33 40 00	Storm Drainage Utilities	Yes					Yes						Yes	Yes					Yes	Coordination Drawings					x			x				
																				Profile Drawings					x			x				

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02 - EXISTING CONDITIONS																																
02 41 13	Selective Site Demolition									Yes								Yes	Yes	Proposed Protection and Control Measures Schedule of Building Demolition Activities Pre-demolition Photographs Landfill Records Statement of Refrigerant Recovery	x x x			x x x				x x x x x				
03 - CONCRETE																																
03 20 00	Concrete Reinforcement	Yes																Yes						x								
03 30 00	Cast-In-Place Concrete	Yes						Yes			Yes			Yes				Yes	Yes	Certification of Compliance Proprietary Material & Items Material & Equipment	x			x x x								
03 38 00	Post-Tensioned Concrete	Yes	Yes					Yes			Yes			Yes				Yes	Yes	Material & Equipment	x			x								
03 41 00	Precast Structural Concrete	Yes	Yes	Yes		Yes	Yes	Yes		Yes	Yes			Yes				Yes	Yes	Erection Plan Welding Certificates Certification of Compliance	x			x x x	x	x						
03 45 00	Precast Architectural Concrete	Yes		Yes		Yes		Yes										Yes			x			x								
03 45 70	Architectural Site-Cast Concrete Wall Panels	Yes						Yes	Yes	Yes								Yes			x			x	x	x						
04 - MASONRY																																
04 20 00	Unit Masonry			Yes			Yes	Yes					Yes					Yes			x			x								
04 72 00	Architectural Cast Stone	Yes		Yes							Yes		Yes			Yes		Yes			x											
05 - METALS																																
05 12 00	Structural Steel	Yes	Yes				Yes		Yes	Yes	Yes		Yes					Yes	Yes	Welding Certificates	x			x	x							
05 12 19	Buckling-Restrained Braces	Yes	Yes						Yes		Yes	Yes	Yes					Yes	Yes	Quality Assurance Plan,Inspection report	x			x								
05 21 00	Steel Joist Framing	Yes	Yes				Yes		Yes	Yes		Yes	Yes	Yes				Yes	Yes	Welding Certificates	x			x								
05 31 00	Steel Decking	Yes					Yes				Yes	Yes	Yes	Yes				Yes	Yes	Welding Certificates	x			x	x							
05 40 00	Cold-Formed Metal Framing	Yes	Yes				Yes		Yes	Yes	Yes	Yes						Yes	Yes	Welding Certificates	x			x								
05 50 00	Metal Fabrications	Yes		Yes						Yes			Yes					Yes	Yes	Welding Certificates	x			x								
05 51 00	Metal Stairs	Yes	Yes				Yes		Yes									Yes			x			x								
05 70 00	Decorative Metal	Yes					Yes											Yes			x	x										
05 73 13	Glazed Decorative Metal Railings	Yes		Yes			Yes				Yes							Yes			x	x		x								
05 73 16	Wire Rope Decorative Metal Railings	Yes		Yes			Yes			Yes	Yes	Yes						Yes			x	x		x								
05 77 30	Smoke Baffle System	Yes		Yes			Yes				Yes			Yes	Yes	Yes		Yes			x											
06 - WOODS AND PLASTICS																																
06 10 00	Rough Carpentry						Yes					Yes						Yes			x											
06 15 00	Wood Decking			Yes			Yes											Yes	Yes	LEED Submittals	x										
06 16 13	Structural Insulating Sheathing	Yes				Yes	Yes									Yes		Yes			x			x								
06 20 00	Finish Carpentry			Yes			Yes					Yes				Yes		Yes			x	x										
06 40 00	Architectural Woodwork	Yes		Yes			Yes						Yes					Yes			x	x										
06 64 00	Plastic Paneling			Yes			Yes											Yes			x	x										
07 - THERMAL AND MOISTURE PROTECTION																																
07 13 26	Pre-Applied Sheet Membrane Waterproofing	Yes		Yes		Yes	Yes									Yes		Yes	Yes	Repair Details	x										
07 14 00	Hot-Applied Membrane Waterproofing			Yes			Yes				Yes		Yes			Yes		Yes	Yes	Manufacturer's certificate that material is appropriate for project.											
																		Yes		On Site Adhesion Test	x										
07 14 50	Fluid-Applied Waterproofing Membrane			Yes			Yes				Yes					Yes		Yes	Yes	Site Visit Report	x										
07 18 00	Traffic Coatings					Yes	Yes			Yes					Yes	Yes		Yes			x											
07 21 00	Thermal Insulation			Yes		Yes	Yes											Yes			x											
07 24 19	Water-Drainage Exterior Insulation and Finish System	Yes		Yes			Yes				Yes	Yes	Yes	Yes	Yes			Yes			x											
07 24 20	Polymer-Based Interior Finish System (IFS)			Yes			Yes			Yes	Yes				Yes			Yes			x											
07 27 01	High Performance Vapor Retarder			Yes		Yes	Yes			Yes								Yes	Yes	Storage	x										
07 27 26	Fluid-Applied Membrane Air Barriers	Yes					Yes											Yes			x											
07 27 27	Fluid-Applied Vapor Impermeable Air Barrier	Yes					Yes											Yes			x											
07 41 13	Metal Roof Panels	Yes		Yes			Yes											Yes			x											
07 42 00	Metal Wall Panels	Yes		Yes			Yes							Yes				Yes	Yes	Coordination Drawings	x										
07 42 63	Fabricated Wall Panel Assemblies	Yes		Yes			Yes			Yes	Yes				Yes	Yes		Yes			x			x	x	x						
07 46 33	Phenolic Wall Siding	Yes			Yes		Yes								Yes			Yes	Yes	Panel Color selection Code Compliance Documents	x										
07 53 23	Ethylene-Propylene-Diene-Monomer (EPDM) Roofing	Yes		Yes		Yes	Yes						Yes			Yes		Yes	Yes	Pre-Installation Meeting Minutes Material & Equipment	x x										
07 54 23	Thermoplastic polyolefin (TPO) Roofing	Yes		Yes		Yes	Yes						Yes			Yes		Yes	Yes	Pre-Installation Meeting Minutes Material & Equipment	x x										
07 62 00	Sheet Metal Flashing and Trim	Yes			Yes											Yes		Yes		Samples for Color Selection	x										
07 71 23	Manufactured Gutters and Downspouts	Yes		Yes			Yes			Yes								Yes			x											
07 72 33	Roof Hatches	Yes					Yes											Yes			x											
07 81 00	Applied Fireproofing	Yes					Yes			Yes	Yes	Yes	Yes					Yes			x											
07 81 60	Intumescent Fireproofing			Yes			Yes						Yes					Yes			x											
07 84 00	Firestopping						Yes			Yes	Yes		Yes					Yes	Yes	Product Schedule	x										
07 92 00	Joint Sealants				Yes		Yes			Yes	Yes		Yes			Yes		Yes	Yes	Color selection	x	x									
																		Yes		Joint Sealant Schedule	x					x					
07 95 00	Preformed Traffic Durable Sealant Systems	Yes		Yes	Yes		Yes						Yes					Yes		Color selection	x	x		x							
08 - OPENINGS																																
08 11 13	Hollow Metal Doors and Frames	Yes					Yes											Yes			x	x										
08 11 16	Aluminum Doors and Frames	Yes		Yes			Yes			Yes	Yes					Yes		Yes			x	x										
08 14 16	Flush Wood Doors	Yes		Yes			Yes									Yes		Yes			x	x										
08 31 13	Access Doors and Frames	Yes					Yes											Yes	Yes	Access Door & Frame Schedule	x	x									
08 33 23	Overhead Coiling Doors	Yes		Yes			Yes								Yes			Yes			x	x										
08 34 73.13	Metal Sound Control Doors	Yes				Yes	Yes					Yes						Yes			x											
08 34 83	Elevator Door Smoke Containment System	Yes				Yes	Yes		Yes	Yes			Yes		Yes	Yes		Yes			x					x							
08 36 16	Single Panel Doors	Yes					Yes								Yes			Yes			x						x					
08 38 00	Traffic Doors	Yes		Yes		Yes	Yes											Yes			x	x										
08 41 13	Aluminum Framed Entrances and Storefronts	Yes		Yes	Yes		Yes			Yes	Yes				Yes	Yes		Yes	Yes	Entrance Door Hardware Schedule. Sealant Color Selection	x	x									
08 42 45	Sliding Aluminum Doors	Yes		Yes		Yes	Yes									Yes		Yes			x	x										
08 43 13	Fire Rated Aluminum Framed Entrances and Storefronts	Yes		Yes			Yes		Yes	Yes			Yes	Yes	Yes	Yes		Yes	Yes	Hardware Schedule Glazing Schedule	x x	x x									
08 44 13	Glazed Aluminum Curtainwalls	Yes		Yes		Yes	Yes		Yes							Yes		Yes			x	x										
08 56 19	Pass Windows	Yes					Yes											Yes			x											
08 71 00	Door Hardware	Yes		Yes						Yes	Yes		Yes			Yes		Yes	Yes	Keying Schedule Door Hardware Sets	x x	x	x							x x	
08 81 00	Glazing			Yes			Yes						Yes			Yes		Yes			x	x										
08 87 13	Solar Control Film	Yes		Yes		Yes	Yes				Yes					Yes		Yes			x											
08 88 13	Fire Resistant Glazing			Yes			Yes						Yes					Yes	Yes	Product Test Listings	x										
09 - FINISHES																																
09 21 16	Gypsum Board Assemblies	Yes					Yes			Yes								Yes			x											
09 21 17	Gypsum Board Shaft Wall Assemblies						Yes											Yes			x											
09 21 16	Gypsum Fiber Reinforced Gypsum Fabrications	Yes					Yes			Yes								Yes			x											
09 30 00	Tiling			Yes			Yes										Yes	Yes			x	x										
09 48 30	Acoustical Treatments			Yes	Yes	Yes	Yes				Yes				Yes			Yes	Yes	MSDS and extra stock	x	x									
09 51 13	Acoustical Panel Ceilings			Yes			Yes					Yes			Yes		Yes	Yes			x	x										
09 54 23	Linear Metal Ceilings			Yes			Yes					Yes			Yes		Yes	Yes			x	x										
09 64 00	Wood Flooring			Yes			Yes								Yes			Yes			x	x										
09 64 66	Wood Athletic Flooring			Yes			Yes											Yes			x	x										
09 65 19	Resilient Tile Flooring			Yes	Yes		Yes								Yes		Yes	Yes		Transition and Nosing color selections.	x	x									
09 65 66	Resilient Athletic Sports Surface	Yes			Yes		Yes							Yes	Yes	Yes		Yes		Color Selection	x	x									
09 67 23	Resinous Flooring			Yes			Yes						Yes		Yes			Yes	Yes	Project Schedule	x	x									
09 68 13	Tile Carpeting			Yes			Yes			Yes	Yes					Yes	Yes	Yes	Yes	Project Schedule	x	x									
09 72 00	Wall Covering			Yes			Yes				Yes				Yes		Yes	Yes			x	x										
09 74 16	Flexible Wood Veneer Wall Covering			Yes		Yes	Yes								Yes			Yes			x	x										
09 75 00	Interior Stone	Yes		Yes			Yes				Yes				Yes		Yes	Yes			x	x										
09 77 26	Surfacing Films	Yes		Yes		Yes	Yes											Yes			x	x										
09 77 50	Vertical Surfacing Panel System			Yes		Yes	Yes								Yes		Yes	Yes	Yes	MSDS	x	x									
09 84 14	Acoustic Stretched-Fabric Wall Systems	Yes		Yes			Yes						Yes					Yes			x	x										
09 84 30	Sound Absorbing Wall and Ceiling Units	Yes		Yes	Yes		Yes			Yes								Yes	Yes	Fabric, color, pattern selection. Extra panels	x	x									
09 91 00	Painting			Yes			Yes											Yes	Yes	Product List	x	x									

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10 - SPECIALTIES																															
10 14 00	Signage	Yes		Yes			Yes											Yes	Yes	Signage Schedule	x	x	x									
																				Wiring Diagrams	x											
10 21 13.16	Plastic-Laminate-Clad Toilet Compartments	Yes					Yes									Yes		Yes	Yes	Product Specification Sheet	x	x										
10 22 36	Coiled Wire Fabric Attachment Systems	Yes		Yes			Yes		Yes				Yes					Yes			x	x										
10 22 38.13	Sliding and Stacking Glass Door Systems	Yes			Yes	Yes	Yes		Yes						Yes			Yes		Finish selection	x	x										
10 23 26	Glass Partition Systems	Yes		Yes		Yes	Yes								Yes	Yes		Yes			x	x										
10 28 13	Toilet and Bath Accessories						Yes											Yes	Yes	Project Schedule	x	x										
10 28 19	Glass Shower Doors	Yes		Yes			Yes								Yes			Yes			x	x										
10 31 00	Manufactured Fireplaces						Yes						Yes			Yes		Yes			x	x			x	x						
10 44 00	Fire Protection Specialties	Yes		Yes			Yes								Yes			Yes			x											
10 73 13	Metal Canopies	Yes		Yes					Yes	Yes			Yes					Yes	Yes	Delegated Design	x			x								
10 82 13	Exterior Equipment Screens	Yes		Yes			Yes		Yes				Yes			Yes		Yes			x				x							
11 - EQUIPMENT																																
11 21 73	Commercial Laundry Equipment						Yes											Yes			x				x	x				x		
11 40 00	Food Service Equipment	Yes					Yes				Yes				Yes			Yes	Yes	Wiring Diagrams	x				x	x						
																		Yes		Project Record Documents	x											
11 66 00	Athletic Equipment	Yes					Yes								Yes			Yes			x	x										
11 66 43	Scoreboards, Timers and Clocks	Yes		Yes			Yes							Yes	Yes	Yes		Yes		Project Record Documents	x											
12 - FURNISHINGS																																
12 56 90	Spa Furniture			Yes			Yes								Yes			Yes			x	x			x	x						
12 92 00	Artificial Plants	Yes		Yes		Yes	Yes								Yes			Yes														
13 - SPECIAL CONSTRUCTION																																
13 11 13	Swimming Pools - General	Yes	Yes					Yes			Yes				Yes	Yes		Yes	Yes	Record Drawings	x			x			x					
																		Yes		Owner Training Video												
13 11 15	Swimming Pool Finishes			Yes		Yes	Yes						Yes			Yes		Yes			x	x					x					
13 11 16	Swimming Pool Piping & Valves						Yes											Yes							x		x					
13 11 30	Prefabricated Swimming Pools	Yes		Yes						Yes						Yes		Yes			x			x			x					
13 11 46	Swimming Pool Equipment & Accessories					Yes	Yes						Yes					Yes		NSF 50 Certification Data	x		x				x					
13 14 13	Water Slides	Yes	Yes	Yes			Yes				Yes							Yes	Yes	Insurance Certificates	x	x			x		x					
13 24 16	Saunas	Yes		Yes			Yes								Yes	Yes		Yes			x	x										
13 34 19	Prefabricated Metal and Fabric Buildings	Yes	Yes	Yes			Yes		Yes				Yes			Yes		Yes			x	x										
13 48 13	Manufactured Sound and Vibration Control Components	Yes		Yes		Yes	Yes						Yes			Yes		Yes			x			x								
14 - CONVEYING EQUIPMENT																																
14 21 50	MRL Electric Traction Passenger Elevators	Yes		Yes			Yes			Yes			Yes		Yes	Yes		Yes	Yes	Continuing Maintenance Proposal	x	x									x	
14 24 00	Hydraulic Elevators	Yes		Yes			Yes			Yes			Yes		Yes	Yes		Yes	Yes	Continuing Maintenance Proposal	x	x									x	
14 26 00	Limited Application Elevator	Yes		Yes			Yes											Yes			x										x	
14 42 16	Vertical Wheelchair Lifts	Yes		Yes			Yes											Yes			x										x	
21 - FIRE SUPRESSION																																
21 05 00	Common Work Results for Fire Suppression												Yes							Welding Certificates					x							
21 05 29	Hangers and Supports for Fire Suppression	Yes					Yes						Yes							Welding Certificates				x	x							
21 05 53	Identification for Fire Suppression						Yes																		x							
21 13 13	Wet-Pipe Fire Suppression	Yes	Yes				Yes		Yes	Yes	Yes		Yes	Yes	Yes				Yes	Welding Certificates					x							
																				Installer Qualifications					x							
22 - PLUMBING																																
22 05 00	Common Work Results for Plumbing												Yes							Welding Certificates					x						x	
22 05 19	Meters and Gauges for Plumbing						Yes																		x						x	
22 05 23	General-Duty Valves for Plumbing						Yes																		x						x	
22 05 29	Hangers and Supports for Plumbing	Yes					Yes						Yes							Welding Certificates					x						x	
22 05 53	Identification for Plumbing						Yes																		x						x	
22 07 00	Plumbing Insulation	Yes					Yes																		x						x	
22 11 16	Domestic Water Piping						Yes																		x						x	
22 11 19	Domestic Water Piping Specialties						Yes								Yes										x						x	
22 11 23	Domestic Water Pumps						Yes								Yes										x						x	
22 11 24	Domestic Water Booster Pumps	Yes					Yes								Yes										x						x	
22 11 25	Facility Natural-Gas Piping	Yes					Yes						Yes	Yes						Welding Certificates					x						x	
22 13 16	Sanitary Waste and Vent Piping						Yes																		x						x	
22 13 19	Sanitary Waste Piping Specialties						Yes								Yes						x	x			x						x	
22 14 16	Storm Drainage Piping						Yes																		x						x	
22 14 19	Storm Drainage Piping Specialties						Yes														x				x						x	
22 14 20	Subdrainage						Yes																		x						x	
22 14 29	Sump Pumps						Yes								Yes	Yes			Yes	Wiring Diagrams					x						x	
22 31 00	Water Softeners	Yes					Yes							Yes	Yes	Yes				Field Quality Control Test Reports					x						x	
22 33 00	Electric Water Heaters	Yes					Yes								Yes	Yes									x						x	
22 34 00	Gas-Fired Water Heaters	Yes					Yes								Yes	Yes									x						x	
22 35 00	Domestic Hot Water Heat Exchangers										Yes		Yes	Yes		Yes				Field Quality Control Reports					x						x	
																				Source Quality Control Reports					x							
22 40 00	Plumbing Fixtures	Yes					Yes								Yes	Yes					x	x			x						x	
22 52 13	Steam Room Generators	Yes					Yes								Yes	Yes					x				x						x	
23 - HEATING, VENTILATING AND AIR CONDITIONING (HVAC)																																
23 05 00	Common Work Results for HVAC										Yes									Welding Certificates					x						x	
23 05 23	General-Duty Valves for HVAC						Yes																		x						x	
23 05 29	Hangers and Supports for HVAC	Yes					Yes				Yes									Welding Certificates				x	x						x	
23 05 53	Identification for HVAC						Yes																		x						x	
23 05 93	Testing, Adjusting, and Balancing																		Yes	Strategies and Procedures Plan					x						x	
																				Certified TAB Reports					x							
23 07 00	HVAC Insulation	Yes					Yes																		x						x	
23 09 00	HVAC Instrumentation and Controls	Yes					Yes							Yes	Yes	Yes			Yes	Field Quality Control Test Reports					x						x	
																				Wiring Diagrams					x							
23 09 90	Commissioning of HVAC																		Yes	Certificates of Readiness					x						x	
																				Certificates of completion of installation, prestart, and startup activities.					x							
23 09 95	Mechanical System Commissioning	Yes													Yes				Yes	Sequences of Operation Submittal					x						x	
																				Control Drawings Submittal					x							
23 21 13	Hydronic Piping						Yes							Yes	Yes					Field Quality Control Test Reports					x						x	
23 21 23	Hydronic Pumps	Yes					Yes								Yes										x						x	
23 31 13	Metal Ducts	Yes					Yes						Yes		Yes				Yes	Welding Certificates					x						x	
																				Delegated-Design Submittals					x							
23 31 16	Nonmetal Ducts	Yes					Yes								Yes										x						x	
23 33 00	Duct Accessories	Yes					Yes								Yes										x						x	
23 34 23	Power Ventilators	Yes					Yes							Yes	Yes					Field Quality Control Test Reports					x						x	
23 36 00	Air Terminal Units	Yes					Yes							Yes	Yes				Yes	Field Quality Control Test Reports					x						x	
																				Delegated-Design Submittals					x							
23 37 13	Diffusers, Registers, Grilles and Louvers						Yes																		x						x	
23 52 16	Condensing Boilers	Yes					Yes							Yes	Yes	Yes			Yes	Field Quality Control Test Reports					x						x	
																				Source Quality-Control Test Reports					x							
23 57 00	Hydronic Heat Exchangers						Yes																		x						x	
23 74 13	Packaged, Outdoor, Air-Handling Units	Yes					Yes							Yes	Yes	Yes				Field Quality Control Test Reports					x						x	
23 74 20	Make-Up Air Unit	Yes					Yes							Yes	Yes	Yes				Field Quality Control Test Reports					x						x	
23 74 23	Energy Recovery Units	Yes					Yes							Yes	Yes	Yes				Field Quality Control Test Reports					x						x	
23 81 26	Split-System Air-Conditioning Units						Yes								Yes						x				x						x	
23 82 39	Electric Heaters	Yes					Yes							Yes	Yes					Field Quality Control Test Reports					x						x	
25 - INTEGRATED AUTOMATION																																
25 10 00	Integrated Automation System - Network Systems	Yes					Yes			Yes					Yes				Yes	See Spec Section for more submittal requirements					x	x					x	
25 20 00	Integrated Automation System - Instrumentation																														x	
25 30 00	Integrated Automation System - Terminations																														x	
25 50 00	Variable Frequency Drives	Yes					Yes												Yes	See Spec Section for more submittal requirements					x	x					x	
25 90 00	Integrated Automation System - Sequence of Operations																														x	
25 50 00	Integrated Automation System - Master Points List																									x	x				x	

Section #	Section Name	Shop Drawings	Signed & Sealed	Samples for Verification	Samples for color selection	Manufactuer's Installation Instructions	Product Data	Mix Design	Calculations	Qualification Data	Test Data/Reports	Research / Evaluation Reports	Certificates	QA/QC Submittals	Operations & Maintenance	Warranty	Quantity Take-offs	Procurement	Other (See Notes)	Notes	ARCH	ID	CODE SPEC.	STRUCT	MECH	ELEC	AQ	CIV	LA ARCH	LT OPS	LT OPS (Cx)	LT IT/AV
26 - ELECTRICAL																															
26 05 19	Low-Voltage Electrical Power Conductors and Cables	Yes				Yes	Yes												Yes	Project Record Documents						x					x	
26 05 23	Control-Voltage Electrical Power Cables	Yes					Yes				Yes									Field Quality Control Test Reports						x					x	
26 05 26	Grounding and Bonding for Electrical Systems	Yes					Yes												Yes	Project Record Documents						x					x	
26 05 29	Hangers and Supports for Electrical Systems	Yes				Yes	Yes			Yes										Installer Qualifications						x					x	
26 05 34	Conduit for Electrical Systems	Yes					Yes												Yes	Project Record Documents						x					x	
26 05 36	Cable Trays for Electrical Systems	Yes				Yes	Yes												Yes	Project Record Documents						x					x	
																				Seismic Bracing (where applicable)						x						
26 05 37	Boxes for Electrical Systems	Yes					Yes																			x					x	
26 05 40	Underfloor Ducts	Yes				Yes	Yes								Yes				Yes	Project Record Documents	x			x		x					x	
																				Maintenance Materials						x						
26 05 48	Vibration and Seismic Controls for Electrical Systems		Yes				Yes		Yes		Yes		Yes							Delegated-Design Submittals (Signed and Sealed)				x		x					x	
																				Welding Certificates						x						
																				Field Quality Control Test Reports						x						
26 05 53	Identification for Electrical Systems	Yes					Yes																			x					x	
26 09 23	Digital Lighting Control System	Yes					Yes								Yes											x					x	
26 27 26	Wiring Devices	Yes					Yes								Yes				Yes	Project Record Documents						x						
																				Maintenance Materials						x					x	
26 29 01	Integrated Low Voltage Distribution & Controls	Yes					Yes								Yes											x					x	
26 51 00	Interior Lighting	Yes		Yes		Yes	Yes				Yes		Yes		Yes					Certificates for Dimming Ballasts	x	x				x					x	
																				Field Quality Control Test Reports						x						
26 56 00	Exterior Lighting	Yes		Yes		Yes	Yes						Yes		Yes				Yes	Sustainable Design Documentation	x					x					x	
																				Certificates for Poles and Accessories						x						
																				Project Record Documents						x						
27 - COMMUNICATIONS																															
27 11 00	Communications Equipment Room Fittings and Pathways	Yes					Yes																			x						x
27 12 00	Identification for Communications Systems	Yes		Yes																						x						x
27 13 50	Structured Cabling for Voice and Data						Yes			Yes	Yes								Yes	Installer Qualifications						x						x
																				Field Test Reports						x						x
																				Project Record Documents						x						x
27 20 00	Ambient Sound Distribution and Masking System	Yes					Yes																			x						x
27 25 00	Audio/Visual Systems and Displays	Yes					Yes																			x						x
27 41 33	Broadband Television Distribution System						Yes							Yes	Yes				Yes	Field Quality Control Test Reports						x						x
																				Project Record Documents						x						x
27 45 00	Video Surveillance						Yes		Yes						Yes	Yes			Yes	Video Storage Capacity Calculations						x						x
																				Project Record Documents						x						x
27 51 29	Area of Refuge Rescue assistance System	Yes					Yes		Yes										Yes	Standby Battery Calculations						x						x
																				Maintenance Contracts						x						x
28 - ELECTRONIC SAFETY AND SECURITY																															
28 31 11	Digital Addressable Fire Alarm System	Yes					Yes			Yes	Yes				Yes				Yes	Project Record Documents						x						
28 31 19	Distributed Antenna System	Yes					Yes								Yes				Yes	System Block Diagrams						x						x
																				Reports and Schedules						x						x
31 - EARTHWORK																															
31 10 00	Site Clearing																		Yes	Existing Conditions								x				
																				Record Drawings								x				
31 23 00	Excavation and Fill						Yes			Yes	Yes		Yes						Yes	Preexcavation Photos or Videos								x				
																				Delivery Slips								x				
31 23 19	Dewatering	Yes								Yes				Yes					Yes	Photographs								x				
31 63 29	Drilled Concrete Piers and Shafts	Yes					Yes	Yes																x				x				
32 - EXTERIOR IMPROVEMENTS																															
32 13 13	Concrete Paving	Yes					Yes	Yes		Yes			Yes					Yes			x											
32 14 00	Unit Paving			Yes			Yes											Yes	Yes	Sieve Analyses	x	x							x			
32 17 23	Pavement Marking						Yes											Yes			x											
32 18 23	Synthetic Field Sport Surfacing			Yes			Yes							Yes		Yes		Yes			x	x										
32 18 25	Athletic Surfacing	Yes		Yes			Yes							Yes				Yes			x	x										
32 31 13	Tennis, Pickleball Fences, Gates and Windscreens	Yes		Yes			Yes									Yes		Yes	Yes	Delegated Design Submittal	x											
32 31 15	Tennis, Pickleball Nets, Posts, Divider Nets and Backing Curtains	Yes					Yes							Yes				Yes			x												
32 31 19	Decorative Metal Fences and Gates	Yes		Yes			Yes								Yes			Yes	Yes	Delegated Design Submittal	x											
32 32 23	Segmented Retaining Walls	Yes	Yes	Yes					Yes				Yes					Yes			x			x				x	x			
32 33 00	Site Furnishings	Yes		Yes			Yes									Yes		Yes			x								x			
32 35 15	Landscape Shade Tops						Yes				Yes		Yes		Yes	Yes		Yes			x											
32 35 16	Outdoor Shade Structures	Yes	Yes	Yes			Yes								Yes	Yes		Yes			x											
32 84 00	Planting Irrigation	Yes					Yes			Yes					Yes			Yes	Yes	Wiring Diagrams	x							x	x			
																				Delegated Design Submittal	x							x	x			
																				Coordination Drawings	x							x	x			
																				Zoning Chart	x							x	x			
																				Controller Timing Schedule	x							x	x			
																				Field Quality Control Reports	x							x	x			
32 92 00	Turf and Grasses						Yes			Yes	Yes							Yes	Yes	Certification of Grass Seed								x	x			
																		Yes		Certification of Seed Mixtures								x	x			
32 93 00	Plants						Yes			Yes	Yes		Yes			Yes		Yes	Yes	Maintenance Instructions	x							x	x			
33 - UTILITIES																															
33 10 00	Water Utilities	Yes					Yes							Yes		Yes			Yes	Coordination Drawings								x				
33 30 00	Sanitary Sewerage Utilities	Yes											Yes	Yes												x		x				
33 40 00	Storm Drainage Utilities	Yes					Yes						Yes	Yes					Yes	Coordination Drawings					x			x				
																				Profile Drawings					x			x				

SECTION 01 40 00
QUALITY REQUIREMENTS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve General Contractor of responsibility for compliance with the Contract Document requirements.
   1. Specified tests, inspections, and related actions do not limit General Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
   2. Requirements for General Contractor to provide quality-assurance and quality-control services required by the Owner or authorities having jurisdiction are not limited by provisions of this Section.

1.02 RELATED SECTIONS

A. Divisions 2 through 33 Sections for specific test and inspection requirements.

1.03 DEFINITIONS

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Life Time.

C. Mockups: Full size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.
   1. Laboratory Mockups: Full-size, physical assemblies constructed at testing facility to verify performance characteristics.

D. Preconstruction Testing: Tests and inspections performed specifically for the Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria.

E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

F. Source Quality-Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.

G. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

I. Installer/Applicator/Erector: General Contractor or another entity engaged by General Contractor as an employee, or subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.

1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade or trades.

J. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of 5 previous projects similar in nature, size, and extent to this Project, with at least one of these being within the past 5 years; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.04 CONFLICTING REQUIREMENTS

A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Owner's Representative for a decision before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Owner's Representative for a decision before proceeding.

1.05 INFORMATIONAL SUBMITTALS

A. General Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting work on the following systems.
   1. Seismic-force resisting system, designated seismic system, or component listed in the designated seismic system quality assurance plan prepared by the General Contractor.
   2. Main wind-force resisting system or a wind-resisting component listed in the wind-force-resisting system quality assurance plan prepared by the General Contractor.

B. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

1.06 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
   1. Date of issue.
   2. Project title and number.
   3. Name, address, and telephone number of testing agency.
   4. Dates and locations of samples and tests or inspections.
   5. Names of individuals making tests and inspections.
   6. Description of the Work and test and inspection method.
   7. Identification of product and Specification Section.
   8. Complete test or inspection data.
   9. Test and inspection results and an interpretation of test results.
   10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
   11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
   12. Name and signature of laboratory inspector.
   13. Recommendations on retesting and re-inspecting.

B. Manufacturer's Field Reports: Prepare written information documenting tests and inspections specified in other Sections. Include the following:
   1. Name, address, and telephone number of representative making report.
   2. Statement on condition of substrates and their acceptability for installation of product.

3. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
4. Results of operational and other tests and a statement of whether observed performance complies with requirements.
5. Other required items indicated in individual Specification Sections.

C. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.07 QUALITY ASSURANCE

A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements. All parties must satisfy the most stringent qualifications specified for the work.

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance. Work shall have occurred within five (5) years.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar to those indicated for this Project in material, design, and extent.

F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.

G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329 and with additional qualifications specified in individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.
1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

H. Manufacturer's Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

I. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
1. General Contractor responsibilities include the following:
a. Provide test specimens representative of proposed products and construction.
b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
c. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
d. When testing is complete, remove test specimens, assemblies, mockups; do not reuse products on Project.

2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect and Owner's Representative, with copy to General Contractor and Subcontractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

J. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
   1. Build mockups in location and of size indicated or, if not indicated, as directed by the Architect or Owner's Representative.
   2. Notify Owner's Representative 7 days in advance of dates and times when mockups will be constructed.
   3. Demonstrate the proposed range of aesthetic effects and workmanship.
   4. Obtain Architect's approval of mockups before starting work, fabrication, or construction.
      a. Allow 7 days for initial review and each re-review of each mockup.
   5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
   6. Demolish and remove mockups when directed, unless otherwise indicated.

K. Laboratory Mockups: Comply with requirements of preconstruction testing and those specified in individual Specification Sections in Divisions 2 through 33.

1.08 QUALITY CONTROL

A. Owner's Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
   1. Owner will furnish General Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
   2. Costs for retesting and re-inspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to General Contractor, and the Contract Sum will be adjusted by Change Order.

B. General Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are General Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.
   1. Where services are indicated as contractor's/subcontractor's responsibility, engage a qualified testing agency to perform these quality-control services.
      a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by general Owner.
   2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
   3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
   4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
   5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Manufacturer's Field Services: Where indicated, engage a manufacturer's representative to observe and inspect the Work. Manufacturer's representative's services include examination of substrates and conditions, verification of materials, inspection of completed portions of the Work, and submittal of written reports.

D. Retesting/Re-inspecting: Regardless of whether original tests or inspections were Subcontractor's responsibility, provide quality-control services, including retesting and re-inspecting, for construction that replaced Work that failed to comply with the Contract Documents.

E. Testing Agency Responsibilities: Cooperate with Owner and General Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Owner and General Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Subcontractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform any duties of Subcontractor.

F. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspecting equipment at Project site.

G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.

1.09 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: The Owner will engage a qualified special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of the Owner, and as follows:

B. Special Tests and Inspections: Conducted by a qualified special inspector as required by authorities having jurisdiction, as indicated in individual Specification Sections, and as follows:
1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.
2. Notifying Owner and General Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality-control service to the Owner, with copy to Subcontractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
6. Re-testing and re-inspecting corrected work.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend

restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Division 1 Section 01 77 00 "Closeout Procedures."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Subcontractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION

SECTION 01 43 39
MOCKUPS

PART 1 GENERAL

1.01 SUMMARY

A. This section includes information on the construction of the required Mockups for Quality Assurance.
   1. Free standing Mockup:
      a. Required Mockup Panel consists of all exterior wall materials that are to comprise the exterior shell of the building.
      b. See Drawings for more information.
   2. First in place Mockups consist of the first complete installation in the course of construction for approval by Architect. The following materials shall be mocked up in this manner:
      a. Intumescent fireproofing.
      b. Sealant Mockup In-place, consisting of sealant color tests for transitions that might not exist on Mockup Panel.
      c. Aluminum framed entrances and storefronts.
      d. Tile and waterproofing.

1.02 RELATED SECTIONS

A. All work must conform to the requirements of the following Sections:
   1. Section 01 31 00 - Project Management and Coordination.
   2. Section 01 33 00 - Submittal Procedures.
   3. Section 01 40 00 - Quality Requirements.
   4. Section 01 60 00 - Product Requirements.

B. The Mockup is to include work of the following Sections:
   1. Section 03 20 00 - Concrete Reinforcement.
   2. Section 03 30 00 - Cast-in-Place Concrete.
   3. Section 03 41 00 - Precast Structural Concrete.
   4. Section 03 45 00 - Precast Architectural Concrete.
   5. Section 03 45 70 - Architectural Site Cast Concrete Wall Panels.
   6. Section 04 20 00 - Unit Masonry Assemblies.
   7. Section 04 72 00 - Architectural Cast Stone.
   8. Section 05 40 00 - Cold-Formed Metal Framing.
   9. Section 06 10 00 - Rough Carpentry.
   10. Section 07 21 00 - Thermal Insulation.
   11. Section 07 24 19 - Water-Drainage Exterior Insulation and Finish System (EIFS).
   12. Section 07 27 01 - High Performance Vapor Barrier.
   13. Section 07 27 26 - Fluid-Applied Membrane Air Barrier.
   14. Section 07 42 00 - Metal Wall Panels.
   15. Section 07 62 00 - Sheet Metal Flashing and Trim.
   16. Section 07 81 60 - Intumescent Fireproofing.
   17. Section 07 92 00 - Joint Sealants.
   18. Section 08 41 13 - Aluminum Framed Entrances and Storefronts.
   19. Section 08 44 13 - Glazed Aluminum Curtainwalls.
   20. Section 08 81 00 - Glazing.
   21. Section 09 21 16 - Gypsum Board Assemblies.
   22. Section 09 30 00 - Tiling.

1.03 REFERENCE STANDARDS

A. All work must conform to the standards specified in its Section.

1.04 SUBMITTALS

A. Submit Product Information and Shop Drawings as required by the relevant Section prior to construction of Mockup.

1. All work in the Mockup must have been previously approved by the submittal process as specified in Section 01 33 00.

1.05 QUALITY ASSURANCE

A. All work in the Mockup must conform to the Quality Assurance standards specified in its Section and Section 01 40 00.

B. Contractor is responsible for maintaining Mockup's structural integrity and necessary access.
   1. Provide Bracing as required.

C. Coordinate the work of all subcontractors to complete the work in a timely manner such that the Mockup can perform its function in the review process.
   1. Notify Architect in advance of completion to schedule review.

PART 2 PRODUCTS

2.01 MATERIALS

A. Provide Materials as shown on Drawing and specified in the appropriate Section.

PART 3 EXECUTION

3.01 PREPARATION

A. All Subcontractors are to prepare for their work in the manner specified in the appropriate Section.
   1. Coordinate all work to occur as it would in the building Construction.

3.02 INSTALLATION

A. All Subcontractors are to install their work in the manner specified in the appropriate Section.
   1. Coordinate all work to occur as it would in the building Construction.
   2. Underlying work is to remain exposed to view such that the work of all trades can be seen.
      a. Coordinate locations of exposed underlying work with Architect and other trades.

B. Free standing Mockup:
   1. See drawings for more information for Mock up Panel.
   2. Panel is to be oriented such that the exterior face is in full.

C. First in place Mockups:
   1. Fabricate Mockups as directed by its specification section.
   2. Mockups that are defined as In place Mockups are to be constructed within the building and may remain as part of the completed Work.
      a. Complete In place mockups first before proceeding to surrounding work.

3.03 INSPECTION AND APPROVAL

A. Contractor to notify Architect of Mockup completion to schedule inspection and approval.

B. Mock ups are to be inspected by representatives of manufacturers providing warranties to certify that the Work complies with the requirements of the warranty(ies).
   1. Representatives may require applicable tests to be performed on Mockup. See individual product section for testing requirements.

C. Work that is not approved shall be amended and re-inspected for approval.
   1. Work may not proceed until Mockup is approved by Architect, manufacturer's warranty representatives.

3.04 SEALANT MOCKUP IN PLACE

A. If all material transitions and their matching sealant color cannot be shown on Mockup Panel, Mockup In-Place of each sealant shall be installed on the Building.
   1. Coordinate installation of Mockup In-place with Architect.
   2. Each color of sealant to be included is to be 3'-0" min length.

B. Do not proceed with Sealant work until colors are approved.

3.05 POST APPROVAL

A. Completed Freestanding Mockup Panel is not to be incorporated into the Building.
   1. Approved Mockups In-place may be incorporated into the Building.

B. Freestanding Mockup Panel is to remain onsite during Construction as an example of approved materials and workmanship.

C. When Construction is completed, Freestanding Mockup Panel is to be demolished by Contractor and lawfully disposed of off site.

END OF SECTION

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SECTION 01 45 33
CODE-REQUIRED SPECIAL INSPECTIONS AND PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General Requirements for Special Inspections, Material Testing and Structural Observations.
   1. See Structural Drawings for more information on structural testing requirements.
   2. See Below for Structural Schedules.

B. Requirements for Steel Components, including:
   1. Structural Steel.
   2. Steel Roof and Floor Decks.
   3. Cold Formed Steel Construction.

C. Requirements for Concrete Construction.

D. Requirements for Masonry Construction.

E. Requirements for Soils.

F. Requirements for Foundations:

G. Requirements for Sprayed Fire-Resistant Materials.

H. Requirements for Mastic and Intumescent Fire Resistant Materials.

I. Requirements for Exterior Insulation and Finish Systems. (EIFS)

J. Requirements for Fire Resistant Penetrations and Joints.

K. Requirements for Smoke Control.

L. Requirements for Architectural Components, including:
   1. Erection and fastening of exterior cladding and interior and exterior veneers.
   2. Erection and fastening of interior and exterior non-bearing walls.
   3. Seismic Requirements for Architectural Components.

M. Requirements for Fabricators.

N. Requirements for Miscellaneous Areas, including:
   1. Suspended Acoustical Ceilings.
   2. Soil Backfill.
   3. Soils for curb and gutter.
   4. Soils for parking lots.
   5. Soils for utility trench backfill.
   6. Reinforcement for slab on grade sidewalks and drive approaches.
   7. Reinforcement for interior slab on grade.
   8. Concrete testing for slab on grade sidewalks and drive approaches.
   9. Concrete testing for interior slab on grade.
   10. Asphalt inspection.
   11. Asphalt testing.
   12. Steam and water line welding.
   13. Special Cases.

1.02 RELATED REQUIREMENTS

A. Section 01 30 00 - Administrative Requirements: Submittal procedures, project meetings, progress schedules and documentation, reports, coordination.

B. Section 01 40 00 - Quality Requirements: Procedures for testing, inspection, mock-ups, reports, certificates; use of reference standards.

C. Section 01 45 34 - Special Inspections Acknowledgements Form.

D. Section 03 20 00 - Concrete Reinforcement.

E. Section 03 30 00 - Cast-in-Place Concrete.
F. Section 03 45 70 - Architectural Site Cast Concrete Wall Panels
G. Section 04 20 00 - Unit Masonry Assemblies
H. Section 05 12 00 - Structural Steel Framing.
I. Section 05 31 00 - Steel Decking.
J. Section 05 40 00 - Cold-Formed Metal Framing.
K. Section 05 50 00 - Metal Fabrications.
L. Section 05 51 00 - Metal Stairs.
M. Section 07 24 19 - Water-Drainage Exterior Insulation and Finish System. (EIFS)
N. Section 07 81 00 - Applied Fireproofing.
O. Section 07 81 60 - Intumescent Fireproofing.
P. Section 07 84 00 - Firestopping.
Q. Section 09 21 16 - Gypsum Board Assemblies.
R. Section 09 51 13 - Acoustic Panel Ceilings.
S. Section 13 14 13 - Waterslides.
T. Section 22 01 00 - General Provisions for Plumbing.
U. Section 22 05 29 - Hangers and Supports for Plumbing.
V. Section 22 11 25 - Facility Natural-Gas Piping.
W. Section 22 13 16 - Sanitary Waste and Vent Piping.
X. Section 22 13 19 - Sanitary Waste Piping Specialties.
Y. Section 22 52 13 - Steam Room Generators.
Z. Section 23 01 00 - General Provisions for HVAC.
AA. Section 23 05 29 - Hangers and Supports for HVAC.
BB. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
CC. Section 26 05 29 - Hangers and Supports for Electrical Systems.

1.03 DEFINITIONS

A. Authority Having Jurisdiction (AHJ): Agency or individual officially empowered to enforce the building, fire and life safety code requirements of the permitting jurisdiction in which the Project is located.

B. Code or Building Code: ICC (IBC), International Building Code, Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements and specifically, Chapter 17 - Special Inspections and Tests.

C. Special Inspection:
   1. Special inspections are inspections and testing of materials, installation, fabrication, erection or placement of components and connections mandated by the AHJ that also require special expertise to ensure compliance with the approved Contract Documents and the referenced standards.

1.04 REFERENCE STANDARDS

A. ICC (IBC) - International Building Code (Current edition)
B. ACI 318 - Building Code Requirements for Structural Concrete 2014, with Errata.
C. ACI 530 - Specification for Masonry Structures 2016.
D. AISC 341 - Seismic Provisions for Structural Steel Buildings 2016.
E. AISC 360 - Specification for Structural Steel Buildings 2010.
F. ASCE 7-16 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures 2016.

G. ASTM C270 - Standard Specification for Mortar for Unit Masonry 2012a, with Editorial Revision.

H. ASTM C476 - Standard Specification for Grout for Masonry 2010.

I. ASTM C1019 - Standard Test Method for Sampling and Testing Grout for Masonry 2016.

J. ASTM C1611 - Standard Test Method for Slump Flow of Self-Consolidating Concrete 2014.

K. ASTM E605/E605M - Standard Test Methods for Thickness and Density of Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members 2019.

L. ASTM E736/E736M - Standard Test Method for Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members 2019.

M. ASTM E2174 - Standard Practice for On-Site Inspection of Installed Firestop Systems 2020a.

N. ASTM E2393 - Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers 2020a.

O. ASTM E2570/E2570M - Standard Test Methods for Evaluating Water-Resistive Barrier (WRB) Coatings Used under Exterior Insulation and Finish Systems (EIFS) or EIFS with Drainage 2007, with Editorial Revision (2014).

P. AWCI 117 - Technical Manual 12-B; Standard Practice for the Testing and Inspection of Field Applied Thin Film Intumescent Fire-Resistive Materials; an Annotated Guide 2014.

Q. AWS D1.1/D1.1M - Structural Welding Code - Steel 2015.

R. AWS D1.4/D1.4M - Structural Welding Code - Steel Reinforcing Bars 2011.

S. IAS AC89 - Accreditation Criteria for Testing Laboratories 2021.

T. IAS AC291 - Accreditation Criteria for Special Inspection Agencies AC291 2019.

U. ICC (IBC)-2018 - International Building Code 2018.

V. SDI (QA/QC) - Standard for Quality Control and Quality Assurance for Installation of Steel Deck 2017.

W. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures 2016.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Owner shall retain one or more qualified agencies to perform Special Inspections.
   1. Special Inspection Agency may retain a separate qualified agency to perform laboratory testing.

B. Special Inspection Agency Qualifications:
   1. Independent firm specializing in performing testing and inspections of the type specified in this section.
   2. Accredited by IAS according to IAS AC291.
   3. Approved by AHJ prior to performing any duties.

C. Inspection Reports:
   1. Reports shall meet requirements of IBC 1704.2.4, AHJ.
   2. Inspection reports are to be submitted to Owner, Construction, Project Manager, and AHJ within 48 hours of performing inspections.
   3. Final inspection report shall be submitted following completion of the project documenting all special inspections performed and a statement indicating that the structure is in compliance with the approved construction documents and applicable codes.

1.06 SUBMITTALS

A. See Section 01 33 00 Submittal Requirements.

B. Special Inspection Agency Qualifications: Prior to the start of work, the Special Inspection Agency is required to:
   1. Submit agency name, address, and telephone number, names of full time registered Engineer and responsible officer.
   2. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.

3. Submit certification that Special Inspection Agency is acceptable to AHJ.
4. Submit documentation that Special Inspection Agency is accredited by IAS according to IAS AC291.

C. Testing Agency Qualifications: Prior to the start of work, the Testing Agency is required to:
1. Submit agency name, address, and telephone number, and names of full time registered Engineer and responsible officer.
2. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.
3. Submit certification that Testing Agency is acceptable to AHJ.
4. Submit documentation that Testing Agency is accredited by IAS according to IAS AC89.

D. Special Inspection Reports: After each special inspection, Special Inspector is required to promptly submit at least two copies of report; one to Architect and one to the AHJ.
1. Include:
a. Date issued.
b. Project title and number.
c. Name of Special Inspector.
d. Date and time of special inspection.
e. Identification of product and specifications section.
f. Location in the Project.
g. Type of special inspection.
h. Date of special inspection.
i. Results of special inspection.
j. Compliance with Contract Documents.
2. Final Special Inspection Report: Document special inspections and correction of discrepancies prior to the start of the work.

E. Certificates: When specified in individual special inspection requirements, Special Inspector shall submit certification by the manufacturer, fabricator, and installation subcontractor to Architect and AHJ, in quantities specified for Product Data.
1. Indicate material or product complies with or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
2. Certificates may be recent or previous test results on material or product, but must be acceptable to Architect and AHJ.

F. Manufacturer's Field Reports: Submit reports to Architect and AHJ.
1. Submit report in duplicate within 30 days of observation to Architect for information.
2. Submit for information for the limited purpose of assessing compliance with information given and the design concept expressed in Contract Documents.

G. Fabricator's Field Reports: Submit reports to Architect and AHJ.
1. Submit report in duplicate within 30 days of observation to Architect for information.
2. Submit for information for the limited purpose of assessing compliance with information given and the design concept expressed in Contract Documents.

PART 2 PRODUCTS

NOT USED.

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS AND SCHEDULE OF SPECIAL INSPECTIONS AND TESTING

A. Perform work as required by AHJ, according to Code and as directed by the construction documents.

B. Frequency of Special Inspections: Special Inspections are indicated as continuous or periodic, as defined below.

1. Continuous Special Inspection: (Cont) Special Inspection Agency is required to be present in the area where the work is being performed and observe the work at all times the work is in progress.
2. Periodic Special Inspection: (Per) Special Inspection Agency is required to be present in the area where work is being performed and observe the work part-time or intermittently and at the completion of the work. Coordinated period with designer and AHJ.
3. Quality Control (QC) refers to items provided by installer, fabricator, erector, or other responsible contractor as applicable. See AISC 360-16 and 341-16.
4. Quality Assurance (QA) shall be provided by parties other than those provding QC when required by the authority having jurisdiction (AHJ), applicable building code (ABC), purchaser, owner or engineer of record (EOR). Nondestructive testing (NDT) shall be performed by the agency or firm responsible for Quality Assurance, except as permitted in accordance with AISC 341, Section N6. See AISC 360-16.
5. Random daily Basis: (O) Inspection occurs during work on a random daily basis. See AISC 360-16.
6. On completion: (P) Inspection to occur prior to acceptance of item. See AISC 360-16.
7. Documentation: (D) Inspector to prepare reports that work was performed per the Contract Documents.
8. Other: (P/O) Perform or Observe.
9. If none of the above is specified, inspection is to be performed once at the time indicated.

C. See AISC 360-16 for definitions of Documents and Tasks.

D. All inspections must be documented as specified.

E. Refer to drawings and individual specification sections for more information.

3.02 REQUIREMENTS FOR SPECIAL INSPECTIONS OF STRUCTURAL STEEL

A. See IBC 1705.2.1, Structural drawings and specifications.

B. If applicable, see also special inspections and testing for seismic resistance.

3.03 STEEL ROOF AND FLOOR DECKS (IBC 1705.2.2; SECTION 6.1 AND APPENDIX 1 OF SDI QA/QC - 2017)

A. **See IBC 1705.2.2, SDI QA/QC - 2017, Section 6.1 and Appendix 1, and Structural drawings and specifications.**

3.04 COLD-FORMED STEEL CONSTRUCTION (OWNER-REQUIRED, IBC 1705.12.2 AND 1705.13.3)

A. **See IBC 1705.12.2 and 1705.13.3, Structural drawings, specifications, certified shop drawings. Some special inspections below are driven by owner preferences and are not part of the building code.**

3.05 CONCRETE CONSTRUCTION

A. **See IBC 1705.3, IBC Chapter 19, AWS D1.4, ACI 318-19, Structural Drawings and Specifications**

3.06 MASONRY CONSTRUCTION

A. See IBC 1705.4, Drawings and Specifications.

3.07 SOILS CONSTRUCTION

A. **See IBC 1705.6, Structural, Civil drawings and specifications.**

3.08 SPRAYED FIRE-RESISTANT MATERIALS

A. **See IBC 1705.15, Architectural drawings and specifications.**

Items	Freq	Instructions
Surface preparation	Per	Prior to application confirm that surface has been prepared per the approved fire-resistance design and manufacturer's instructions.
Application	Per	Substrate shall have min ambient temperature and ventilation before and

		after application per approved manufacturer instructions.
Material thickness	Per	Samples shall be taken from selected floor, roof and wall assemblies and structural members. No more than 10% of the samples shall be less than the thickness required by the fire-resistance design.
Material density	Per	Density tests shall be performed in accordance with ASTM E 605 for every 2,500 sqft of floor, roof or wall area. One sample must also be provided for each beam, girder, truss or column at each story.
Bonding Strength	Per	Bond strength tests shall be performed in accordance with ASTM E 736 for every 2,500 sqft of floor, roof or wall area. One sample must also be provided for each beam, girder, truss or column at each story. The bond strength shall not be less than 150psf.

3.09 MASTIC AND INTUMESCENT FIRE-RESISTANT COATINGS

A. **See IBC 1705.16, Architectural drawings and specifications.**

Items	Freq	Instructions
Surface preparation	Per	Prior to application confirm that surface temperature and substrate are acceptable and that a compatible primer is used in accordance with AWCI 12-B
Thickness	Per	Record thickness of primer or other existing coating on substrate prior to application of coating. Final thickness of coating must be verified in multiple locations prior to applying top coat per AWCI 12-B.

3.10 EXTERIOR INSULATION AND FINISH SYSTEMS (EIFS)

A. **See IBC 1705.17, Architectural drawings and specifications.**

Items	Freq	Instructions
Material and installation	Per	Verify that water-resistive barrier, complying with ASTM E 2570, is installed appropriately over a sheathing substrate.

3.11 FIRE-RESISTANT PENETRATIONS AND JOINTS

A. **See IBC 1705.18, Architectural drawings and specifications.**

Items	Freq	Instructions
Penetration firestops	Per	Listed systems shall be inspected in accordance with ASTM E 2174.
Fire-resistant joint systems	Per	Listed systems shall be inspected in accordance with ASTM E 2393.

3.12 SMOKE CONTROL

A. **See IBC 1705.19, Mechanical drawings and specifications.**

Items	Freq	Instructions
Verify device locations and perform leakage testing	Per	During erection of ductwork and prior to concealment.
Pressure difference testing, flow measurements and detection control verification	Per	Prior to occupancy and after sufficient completion.

3.13 SPECIAL INSPECTIONS FOR SEISMIC RESISTANCE: ARCHITECTURAL COMPONENTS

A. **See IBC 1705.12.5, Architectural drawings and specifications.**

Special Inspections for seismic resistance: For the seismic force-resisting systems of structures assigned to Seismic Design Category C, D, E or F		
Items	Freq	Instructions
Erection and fastening of exterior cladding	Per	Verify appropriate materials, fasteners and attachment at commencement of work and at completion. Applies for components 30 feet or more above grade and weighing more than 5 psf.
Erection and fastening of exterior nonbearing walls	Per	Verify appropriate materials, fasteners and attachment at commencement of work and at completion. Applies for components 30 feet or more above grade.
Erection and fastening of interior nonbearing walls	Per	Verify appropriate materials, fasteners and attachment at commencement of work and at completion. Applies for components 30 feet or more above grade and weighing more than 15 psf.
Erection and fastening of interior and exterior veneers	Per	Verify that anchorage complies with approved construction documents. Applies for components 30 feet or more above grade and weighing more than 5 psf. Inspection of post-installed anchors shall comply with approved ICC-ES report.

3.14 FABRICATORS

A. **See IBC 1704.2.5 & 1705.11, drawings and specifications of relevant discipline.**

Items	Freq	Instructions
By product listed above, designer/discipline, or AHJ	By designer or AHJ	Perform according to designer's or AHJ's requirements

3.15 MISCELLANEOUS AREAS

A. **See drawings and specifications of the appropriate discipline.**

Items	Freq	Instructions
By designer/discipline or AHJ.	By designer or AHJ	Perform according to designer's or AHJ's requirements.

END OF SECTION

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ACKNOWLEDGEMENTS

(Each appropriate representative shall sign below)

Owner:		Firm:		Date:	
Contractor:		Firm:		Date:	
Architect:		Firm:		Date:	
SER:		Firm:		Date:	
SI-S:		Firm:		Date:	
SI-T:		Firm:		Date:	
ITA		Firm:		Date:	
ITA:		Firm:		Date:	
F:		Firm:		Date:	
F:		Firm:		Date:	

Legend: SER – Structural Engineer of Record SI-T – Special Inspector - Technical F – Fabricator SI-S – Special Inspector - Structural ITA – Independent Testing Agency

ACCEPTED FOR THE BUILDING DEPARTMENT BY _____DATE:_____

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ACKNOWLEDGEMENTS

(Each appropriate representative shall sign below)

Owner:	_____	Firm:	_____	Date:	_____
Contractor:	_____	Firm:	_____	Date:	_____
Architect:	_____	Firm:	_____	Date:	_____
SER:	_____	Firm:	_____	Date:	_____
SI-S:	_____	Firm:	_____	Date:	_____
SI-T:	_____	Firm:	_____	Date:	_____
ITA	_____	Firm:	_____	Date:	_____
ITA:	_____	Firm:	_____	Date:	_____
F:	_____	Firm:	_____	Date:	_____
F:	_____	Firm:	_____	Date:	_____

Legend: SER – Structural Engineer of Record SI-T – Special Inspector - Technical F – Fabricator SI-S – Special Inspector - Structural ITA – Independent Testing Agency

ACCEPTED FOR THE BUILDING DEPARTMENT BY _____DATE:_____

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SECTION 01 60 00
PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

1.02 RELATED SECTIONS

A. Section 01 33 00 - Submittal Procedures for requests for substitutions.

B. Section 01 40 00 - Quality Requirements for testing requirements of products.

C. Divisions 2-33 - All products in all sections must comply with the standards specified herein.

1.03 DEFINITIONS

A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
   1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
   2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
   3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Basis-of-Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

1.04 SUBMITTALS

A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product, fabrication, or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
   1. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify General Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.
      a. Form of Approval: As specified in Division 1 Section 01 33 00 "Submittal Procedures."
      b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.

B. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 1 Section 00 33 00 "Submittal Procedures." Show compliance with requirements.

1.05 QUALITY ASSURANCE

A. Compatibility of Options: If Subcontractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

1.06 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Products are to be procured no later than 30 days after return of approved submittals.

1. Submit receipts and delivery schedule for all products.

B. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
   1. Submit inventory of products to Owner within 5 days of receipt.

C. Delivery and Handling:
   1. Coordinate all material receiving, handling, trucking, and storage per site-specific conditions.
      a. Review site logistics at time of bid to determine material storage requirements of each subcontractor.
   2. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
   3. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
   4. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
   5. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.

D. Storage, general:
   1. Store products to allow for inspection and measurement of quantity or counting of units.
   2. Store materials in a manner that will not endanger Project structure.
   3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
   4. Store foam plastic and other vulnerable products away from exposure to sunlight, except to extent necessary for period of installation and concealment.
   5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
   6. Protect stored products from damage and liquids from freezing.

E. Off-Site Storage:
   1. Materials procured for Life Time and stored off of the project site must comply with the following requirements:
      a. Materials must be clearly labeled and wrapped.
         1) Materials procured for Life Time may NOT be used on other projects.
      b. Materials must be insured against loss or damage.
      c. Storage facility must be available for inspection by Life Time personnel or representatives.
      d. Submit inventory of materials delivered within 5 days of delivery.

1.07 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Subcontractor of obligations under requirements of the Contract Documents.
   1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
   2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
   1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
   2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
   3. Refer to Divisions 2 through 33. Sections for specific content requirements and particular requirements for submitting special warranties.

C. Installer's warranty.
   1. Provide standard 1 year Installer's Warranty for all products.

D. Submittal Time: Comply with requirements in Division 1 Section 01 77 00 "Closeout Procedures."

PART 2 PRODUCTS

2.01 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
   1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
   2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
   3. Architect and Owner reserve the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
   4. Where products are accompanied by the term "as selected," Architect will make the selection.
   5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.

B. Product Selection Procedures:
   1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Subcontractor's convenience will not be considered.
   2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Subcontractor's convenience will not be considered.
   3. Products:
      a. Restricted List: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Subcontractor's convenience will be considered.
      b. Non-restricted List: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product.
   4. Manufacturers:
      a. Restricted List: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Subcontractor's convenience will be considered.
      b. Non-restricted List: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed manufacturer's product.
   5. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

C. Visual Matching Specification: Where Specifications require "match Architect's sample", provide a product that complies with requirements and matches Owner Representative’s sample. Owner Representative’s decision will be final on whether a proposed product matches.
   1. If no product available within specified category matches and complies with other specified requirements, submit a Substitution Request Form per Section 00 43 25 for proposal of product.

D. Visual Selection Specification: Where Specifications include the phrase "as selected by the Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. The Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.02 PRODUCT SUBSTITUTIONS

A. Timing: Architect will consider requests for substitution if received within 60 days after the Notice to Proceed. Requests received after that time may be considered or rejected at discretion of Architect.

B. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

1. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
2. Requested substitution does not require extensive revisions to the Contract Documents.
3. Requested substitution is consistent with the Contract Documents and will produce indicated results.
4. Substitution request is fully documented and properly submitted.
5. Requested substitution will not adversely affect Contractor's Construction Schedule.
6. Requested substitution has received necessary approvals of authorities having jurisdiction.
7. Requested substitution is compatible with other portions of the Work.
8. Requested substitution has been coordinated with other portions of the Work.
9. Requested substitution provides specified warranty.
10. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

2.03 COMPARABLE PRODUCTS

A. Where products or manufacturers are specified by name, submit the following, in addition to other required submittals, to obtain approval of an unnamed product:

1. Evidence that the proposed product does not require extensive revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
5. Samples, if requested.

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 64 00
OWNER-FURNISHED PRODUCTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Procedures for Coordination and Installation of Owner Furnished Products.
   1. See Supplementary bidding materials for ennumeration of Owner Furnished Products.

1.02 RELATED REQUIREMENTS

A. Section 01 10 00 - Summary: Contract descriptions, description of alterations work, work by others, future work, occupancy conditions, use of site and premises, work sequence.

B. Section 01 77 00 - Closeout Procedures: Examination, preparation, and general installation procedures; preinstallation meetings; cutting and patching; cleaning and protection; starting of systems; demonstration and instruction; closeout procedures except payment procedures; requirements for alterations work.

1.03 REFERENCE STANDARDS

A. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

B. UL (DIR) - Online Certifications Directory Current Edition.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate delivery, storage and installation of all Owner Furnished materials indicated to be installed by Contractor.

B. Coordinate construction activities with Owner Furnished materials indicated to be installed by Owner, such that other construction activities do not interfere with the installation of these materials.

C. Coordinate installation of all items in this section with all impacted trades.

D. Coordinate installation of Owner-installed and Vendor-installed products with Owner and Vendor.

1.05 SUBMITTALS

A. Show Owner furnished items on shop drawings when they impact the work of other Sections.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Coordinate delivery of Owner furnished products with Owner or Vendor.

B. Store Owner-furnished products according to manufacturer's recommendations.
   1. See Section 01 60 00 for requirements of off-site storage of materials.

C. General Contractor to receive, unload, distribute and install Owner-furnished products indicated to be installed by Contractor unless otherwise directed, in writing, from Owner’s Representative.

1.08 FIELD CONDITIONS

A. Do not install Owner-furnished products when field conditions do not meet manufacturer's requirements.

PART 2 PRODUCTS

2.01 OWNER-FURNISHED PRODUCTS

A. See Supplementary Bidding Materials.

PART 3 EXECUTION

3.01 INSTALLERS

A. All Owner-furnished Products to be installed by workers skilled in the appropriate trades.

3.02 EXAMINATION

A. Verification of Conditions: Verify that conditions at installation location are suitable for installation.
   1. Verify that electrical, plumbing, data or utility hookups are present and compatible, if applicable.

B. If conditions are not acceptable, notify Architect.

3.03 PREPARATION

A. Protection of In-Place Conditions: Protect all adjacent materials and finishes.

3.04 INSTALLATION

A. Install in accordance with manufacturer's instructions.

3.05 REPAIR

A. Repair any damage to surrounding materials and finishes that may have occurred during installation.

3.06 SYSTEM STARTUP

A. Prepare and start equipment and systems in accordance with manufacturers' instructions and recommendations.

B. Verify that all Owner-furnished items function as required after installation.

3.07 CLEANING

A. Clean Owner-furnished product and surrounding finishes as required.

3.08 PROTECTION

A. Protect installed Owner-furnished product from subsequent construction operations.

END OF SECTION

SECTION 01 77 00
CLOSEOUT PROCEDURES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
   1. Substantial Completion procedures.
   2. Final completion procedures.
   3. Warranties.
   4. Final cleaning.

1.02 RELATED SECTIONS:

A. Divisions 2 through 33 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

B. Section 00 52 00 - Agreement Forms

C. Section 00 72 00 - General Conditions

1.03 SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete with request.
   1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
   2. Advise Owner's Representative of pending insurance changeover requirements.
   3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
   4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
   5. Prepare and submit Project Record Documents, As-Built Drawings, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information. See Section 01 78 39.
   6. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
   7. Make final changeover of permanent locks and deliver keys to Owner's Representative. Advise Owner's Representative personnel of changeover in security provisions.
   8. Complete startup testing of systems.
   9. Submit test/adjust/balance records.
   10. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements only after successful completion of Functional Testing. See Section 01 91 13.
   11. Advise Owner's Representative of changeover in heat and other utilities.
   12. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
   13. Complete final cleaning requirements, including touchup painting.
   14. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Architect will either proceed with inspection or notify the General Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify the General Contractor of items, either on the General Contractor's list or additional items identified by the Architect or Owner, that must be completed or corrected before certificate will be issued.
   1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
   2. Results of completed inspection will form the basis of requirements for final completion.

1.04 FINAL COMPLETION

A. Preliminary Procedures: Before requesting final inspection for determining final completion, complete the following:
   1. Submit a final Application for Payment according to Division 0 Section 00 52 00 "Agreement Forms" and Division 0 Section 00 72 00 “General Conditions.”
   2. Submit certified copy of Architect’s Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by the Architect. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
   3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
   4. Submit pest-control final inspection report and warranty.
   5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.

B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, the Architect will either proceed with inspection or notify General Contractor of unfulfilled requirements.
   1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.05 WARRANTIES

A. Submittal Time: Submit written warranties on request of Owner’s Representative for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.

B. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.
   1. Submit warranties via Project Website (Procore)
   2. Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide table of contents at beginning of document.

C. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 PRODUCTS

2.01 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
   1. Use cleaning products that meet Green Seal GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 EXECUTION

3.01 FINAL CLEANING

A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
   1. General Contractor to complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:
      a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
      b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
      c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
      d. Remove tools, construction equipment, machinery, and surplus material from Project site.

e. Remove snow and ice to provide safe access to building.
f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
h. Sweep concrete floors broom clean in unoccupied spaces.
i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
k. Remove labels that are not permanent.
l. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
    1) Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates.
m. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
n. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
o. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
p. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
q. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
r. Leave Project clean and ready for occupancy.

C. Pest Control: Engage an experienced, licensed exterminator to make a final inspection and rid Project of rodents, insects, and other pests. Prepare a report.

END OF SECTION

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SECTION 01 78 39
PROJECT RECORD DOCUMENTS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes administrative and procedural requirements for project record documents, including the following:
   1. Record Drawings.
   2. Record Specifications.
   3. Record Product Data.

B. Related Sections:
   1. Division 1 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
   2. Divisions 2 through 33 Sections for specific requirements for project record documents of the Work in those Sections.
   3. Section 00 40 00 Contract Packet Forms; Warranty and Standard Construction Subcontract.

1.02 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:
   1. Submit electronically, via Procore.
   2. Number of Copies: Submit 1 set of marked-up record prints.
   3. Number of Copies: Submit copies of record Drawings as follows:
      a. Initial Submittal: Submit PDF electronic files of marked-up record prints. LTF Construction will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
      b. Final Submittal: Submit PDF electronic files of marked-up record prints. Print each Drawing, whether or not changes and additional information were recorded.

B. PDF electronic files Record Product Data: Submit annotated PDF electronic files and directories of each submittal.

PART 2 PRODUCTS

2.01 RECORD DRAWINGS

A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings.
   1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
      a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
      b. Record data as soon as possible after obtaining it.
      c. Record and check the markup before enclosing concealed installations.
   2. Mark the Contract Drawings and Shop Drawings completely and accurately. Utilize personnel proficient at recording graphic information in production of marked-up record prints.
   3. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
   4. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with LTF Construction. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
   1. Format: Same digital data software program, version, and operating system as the original Contract Drawings.

2. Format: DWG, operating in Microsoft Windows operating system.
3. Format: Annotated PDF electronic file with comment function enabled.
4. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
5. Refer instances of uncertainty to LTF Construction for resolution.

C. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Format: Annotated PDF electronic file with comment function enabled.
3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
4. Identification: As follows:
a. Project name.
b. Designation "PROJECT RECORD DRAWINGS."
c. Name of Subcontractor.

2.02 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
4. Note related Change Orders, record Product Data, and record Drawings where applicable.

B. Format: Submit record Specifications as annotated PDF electronic file.

2.03 RECORD PRODUCT DATA

A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. Note related Change Orders, record Specifications, and record Drawings where applicable.

B. Format: Submit record Product Data as annotated PDF electronic file.

2.04 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

B. Format: Submit miscellaneous record submittals as PDF electronic file.

PART 3 EXECUTION

3.01 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and modifications to project record documents as they occur; do not wait until the end of Project.

B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible

condition, protected from deterioration and loss. Provide access to project record documents for LTF Construction reference during normal working hours.

END OF SECTION

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SECTION 01 84 21
INTERIOR CONCRETE FLOOR FINISHING PERFORMANCE REQUIREMENTS.

PART 1 GENERAL

1.01 SUMMARY

A. Work of this Section includes requirements for developing content relating to construction of concrete slabs-on-grade and suspended slabs (concrete flatwork) for the Contractor's Quality Management Program (QMP) specified in Section 01 45 00 – Quality Control that documents the policies and organizational structure to achieve specified concrete finishing tolerances for concrete substrates associated with the following:

1. Concrete Mix Design: Prepare concrete mix design that accounts for appropriate workability (slump and flow) based on performance requirements for the Project, and that accounts for concrete trades' requirements to achieve specified concrete tolerances including adjustment for slump and consolidation on site, inclusion of shrinkage compensating admixtures and applied floorcovering manufacturers' requirements.
2. Concrete Formwork: Prepare formwork erection drawings for suspended slabs in accordance with CSA A23.1, Item 6.5.2 and verify that perimeter (FL) of horizontal concrete slabs and blocked-out openings through slabs are at the same level [; including service and crane block-outs in suspended slab construction, accounting for formwork camber]; and verify that construction schedule accounts for specified strength gain before removal and relocation.
3. Concrete Reinforcement: Schedule installation of concrete reinforcement to allow sufficient time for Construction Manager's review and acceptance before scheduling delivery of concrete to project site.
4. Concrete Delivery: Control delivery of concrete to maintain concrete mix design properties accepted by the Consultant at time of discharge, without use of unscheduled additives and water by the transit mix operator and onsite personnel.
5. Concrete Finishing: Coordinate with Section 03 30 for specified FF:FL tolerances and locations of different FF:FL outcomes (the footprint), that account for admixtures required to attain optimal concrete workability for placers and finishers, and that are compatible with adhesives used for applied finishes and floorcoverings.
6. Concrete Protection: Describe methods to protect newly placed and finished concrete from rain and snow, freezing conditions, wind, heat and differential shading until concrete is cured sufficiently to prevent damage to surface finish, and confirm methods to limit loads on new concrete slabs until sufficient strength is attained to support construction loads.
7. Concrete Curing: Describe methods for managing application and removal of Products used to aid the concrete curing process, with the goal to minimize the use of surface applied curing compounds, sealer/hardeners and moisture retarders that may be detrimental to surface adhesion for floorcoverings and underlayments.
8. Concrete Surface Preparation: Describe methods for managing removal of incompatible curing compounds and providing concrete surface profiles acceptable for bonding of floorcovering adhesives.

1.02 RELATED REQUIREMENTS

A. Section 03 20 00 - Concrete Reinforcement: Requirements for steel reinforcing bars for slabs-on-grade.

B. Section 03 30 00 - Cast in Place Concrete: Establish requirements for maximum surface density of placed concrete when using supplementary cementing materials [and shrinkage compensating admixtures] to achieve floorcovering manufacturer's requirements for effective adhesive bond.

C. Section 05 31 00 - Steel Decking: Management of loading and spreading of concrete associated with composite concrete and steel decking to minimize deflection of steel decking between joists and achieve Concrete Quantitative Tolerance (FF:FL).

D. Section 07 18 00 - Traffic Coatings: Minimum Concrete Quantitative Tolerance (FF:FL) required for installation of resinous traffic toppings.

E. Section 09 05 61 - Common Work Results for Flooring Preparation: Preparation of concrete slab surfaces using cementitious repair and filling materials, moisture mitigation compounds and surface grinding required to achieve Floorcovering Qualitative Tolerances (Straightedge) ready for installation of floorcoverings.

F. Section 09 30 00 - Tiling: Minimum surface tolerances required for installation of tiling products.

G. Section 09 64 66 - Wood Athletic Flooring: Minimum surface tolerances required for installation of athletic wood assemblies.

H. Section 09 65 19 - Resilient Flooring: Minimum surface tolerances required for installation of resilient floorcoverings.

I. Section 09 67 23 - Resinous Flooring: Minimum surface tolerances required for installation of Resinous Flooring.

J. Section 09 68 13 - Tile Carpeting: Minimum surface tolerances required for installation of tile carpeting.

K. Section 22 13 19 - Sanitary Waste Piping Specialties: For coordination with floor drains.

1.03 DEFINTIONS

A. Floorcoverings: Surface finishes that are directly adhered to concrete substrates such as resilient flooring, carpeting, wood flooring, laminate flooring, and other similar flexible premanufactured finishes.

B. Applied Finishes: Surface finishes that are applied to concrete such as exposed architectural concrete finishing (polished, burnished or densified), tile flooring, masonry flooring, terrazzo flooring and similar rigid finish materials, supported wood flooring, fluid applied flooring, and other flooring treatments that are not otherwise defined as floorcoverings.

C. Concrete Surface Profile (CSP): Topographical contour, surface texture of exposed concrete surfaces or substrates as defined by the International Concrete Repair Institute (ICRI), and are required to establish acceptable mechanical bond between floorcoverings, applied finishes, mortar setting materials, fluid applied flooring, or cementitious coatings with individual material CSP requirements specified in RELATED REQUIREMENTS.

D. Concrete Finishing Tolerances: The relative flatness and levelness of horizontal concrete surfaces identified to receive floorcoverings or other applied finishes, and that have different measurement standards and tolerances based on the component of the work and time of installation:
   1. Concrete Quantitative Tolerance (FF:FL): Concrete flatness (FF) and levelness (FL), based on quantitative results using ASTM E1155 measurements and surface tolerances described in CSA A23.1, Table 21: and that are measured within 3 days of placement before to removal of concrete forms.
   2. Floorcovering Qualitative Tolerance (Straightedge): Concrete flatness based on qualitative evaluation of observed gap measured along a 3 m unlevelled straightedge placed randomly.

E. Concrete Floor Finishing Tolerances: Concrete finishing tolerances generally apply to entire slab areas; materials and methods associated with achieving tolerances vary based on when they are measured, and which Subcontractor is directed by the General Contractor to perform work to achieve the specified tolerance as follows:
   1. Conventional Tolerance Concrete Floor Finishing: Concrete slabs having finishing tolerances for concrete substrates ranging between FF 20:FL 15 and FF 35:FL 25 specified in Section 03 30 00.

1.04 REFERENCE STANDARDS

A. American Concrete Institute (ACI):
   1. ACI 117.1R-14, Guide for Tolerance Compatibility in Concrete Construction

B. ASTM International (ASTM):
   1. ASTM E1155-20, Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers

2. ASTM F710-19e1, Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring

C. Canadian Standards Association (CSA):
   1. CSA A23.1:19/A23.2:19, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete

D. National Floor Covering Association of Canada (NFCA):
   1. NFCA Floor Covering Reference Manual

1.05 ADMINISTRATIVE REQUIREMENTS

A. Contractor's Quality Management Program (QMP): Submit QMP indicating standardized approach to managing quality of materials and workmanship during execution of the work associated with achieving concrete finishing tolerances identified in the Specifications including the following:
   1. Preconstruction Quality Planning: Develop preconstruction activities forming a part of the QMP in accordance with CSA A23.1, Article 7.1 and requirements of this Section.
   2. Quality Assurance: Activities, actions, corrective remedies and procedures performed before and during execution of the Work by the Contractor to protect against defects and deficiencies, and confirming that construction is consistent with specified performance requirements listed within the Specification.
   3. Quality Control: Observations, procedures, and related actions performed by the Contractor during and after execution of the Work to verify that completed construction complies with specified performance requirements, standards and technical requirements listed within the Specifications

B. Subcontractor Contribution: Subcontractors will coordinate requirements described in this section with the Contractor to identify installation conditions affecting concrete placing and finishing, and that affect compatibility of floorcoverings discussed during the pre-construction meetings described below, Contractor will incorporate comments as a part of the QMP.

C. Pre-Construction Tolerance Coordination Meetings: Conduct pre-construction tolerance coordination meetings in accordance with Section 01 31 00 – Project Management and Coordination, attended by Owner, Architect, Construction Manager, General Contractor and Subcontractors whose work is affected by work of this Section to discuss the following before starting any concrete related construction:
   1. Calculated changes to floor flatness profiles arising from natural changes to concrete such as shrinkage, curling, creep or plastic deformation that will occur between performing measurements for Concrete Quantitative Tolerances and measurements for Floorcovering Qualitative Tolerances;
   2. Methods for aligning measurement tolerances for individual trade contributions to the work, to those required by other parts of the work;
   3. Confirming concrete density, absorption and surface profile required for installation of applied finishes and floorcoverings;
   4. Identify any conflicts between adjacent components of the work that have potential to affect achieving the measurement tolerances required for individual contributions to the work;
   5. Resolve issues and implement management controls associated with meeting specified tolerances;
   6. Management of unit price allowances described by this Section associated with meeting specified tolerances;
   7. Management of temporary heating to maintain optimal concrete curing, and management of temperature and humidity required for installation of applied finishes and floorcoverings; and
   8. Other topics affecting the work described in this Section.

D. Pre-Construction Meetings: Conduct pre-construction meetings starting approximately 1 month before starting concrete work, and throughout the construction phase as necessary to achieve specified performance requirements in accordance with Section 01 31 00 – Project Management and Coordination, attended by Owner, Architect, Construction Manager, General Contractor and Subcontractors whose work is affected by work of this Section to discuss the following:

1. Best Practices Meetings: Confirm best practices relating to workmanship required to achieve specified floor finishing performance including the following:
    a. Sequence of work and confirmation of compatibility of installed materials and substrates;
    b. Using forming methods that limit potential deviation from specified performance requirements;
    c. Using placing and finishing methods that limit potential deviation from specified performance requirements;
    d. Responsibility for completion of substrate preparation and ambient weather measurements performed by Subcontractor.
    e. Responsibility for measurements and testing performed by Testing Agency described in this Section;
    f. Installation follow-up procedures to reduce or eliminate substrate and installation deficiencies;
    g. Using experienced, trained or certified Subcontractors for components critical to achieving specified performance requirements;
    h. Other procedures identified during best practices meetings that affect work results described in this Section.
2. Flatness/Levelness Surveying: Confirm access and survey frequency for collection of finishing tolerances for concrete substrates specified in Section 03 30 00. Confirm floor slopes in areas indicated to be sloped on drawings.
3. Concrete Quantitative Tolerance (FF:FL): Confirm that Concrete Quantitative Tolerance meets requirements specified in Section 03 30 00 prepared at time of concrete placement;
4. Floorcovering Qualitative Tolerance (Straightedge): Confirm that Floorcovering Qualitative Tolerance meets requirements for floorcoverings listed in RELATED REQUIRMENTS, accounting for natural changes to flatness profile arising from shrinkage, curling or plastic deflection of concrete slabs, and installation of self-levelling compounds and surface preparation products;
5. Condition of Substrates: Confirm that concrete substrate conditions are acceptable to floorcovering manufacturer requirements for relative humidity, mechanical bond and porosity, smoothness and other conditions affecting quality of floorcovering installation;
6. Measurement and Testing Frequency: Determine frequency and timing of site testing and observation reporting of floorcoverings substrates to confirm acceptability for manufacturers installation requirements; and
7. Other topics affecting work described in this Section.

E. Coordination: Coordinate qualification requirements and contributions from Division 03 and requirements from Division 09 associated with interior concrete floor finishing performance as follows:
1. Coordinate concrete mix design and confirm workability of mix to achieve finishing tolerances for concrete substrates specified in Section 03 30 00, and confirm compatibility with bonding performance required by products specified in RELATED REQUIREMENTS.
2. Coordinate with concrete floor finishing Subcontractors and confirm they employ sufficient numbers of qualified and experienced personnel during concrete placement operations to achieve finishing tolerances for concrete substrates specified in Section 03 30 00
3. Coordinate concrete curing methods proposed for use on the Project as specified in Section 03 30 00 with RELATED REQUIREMENTS and confirm that curing methods and materials, and substrate remediation methods are compatible with installation of floorcoverings and other applied finishes.
4. Coordinate requirements for measurements, testing and preparation of concrete substrates as specified in Section 03 30 00 and Section 09 05 61.
5. Coordinate with Subcontractors responsible for cementitious topping and underlayments Subcontractors and confirm methods for unit price allowance management, contributions to floor finishing mock-up specified in this Section and confirm products proposed for use.
6. Coordinate Subcontractors contributing to floor finishing mock-up described in this Section.

F. Scheduling: Schedule concrete placing and finishing to account for floor finishing performance requirements described in this Section and required by RELATED REQUIREMENTS, and as follows:
   1. Schedule delivery of concrete to prevent use of unscheduled water and additives being added to the mix during transport or as a consequence of delays at time of discharge without prior approval from Construction Manager.
   2. Schedule concrete formwork removal in accordance with Section 03 30 00, early removal of formwork will not be permitted unless specifically directed by the Construction Manager.
   3. Schedule concrete placing and finishing operations to minimize exposure to adverse weather conditions in accordance with CSA A23.1, Article 7.6.
   4. Schedule measurements and testing performed by Subcontractors responsible for work results specified in RELATED REQUIREMENTS.

1.06 SUBMITTALS

A. Provide required information in accordance with Section 01 33 00 Submittal Procedures.

B. Information Submittals: Provide the following submittals during the course of work of this Section:
   1. Concrete Placing and Finishing Records: Submit written records for each concrete placement including the following:
      a. Volume, location and date of concrete placement relating to gridlines indicated on Drawings;
      b. Weather conditions on date of concrete placement;
      c. Building enclosure conditions on date of concrete placement;
      d. Temperature of granular base for slabs-on-grade, or ambient temperature of formwork substrate; and
      e. Any unusual observations or conditions affecting concrete placement.
   2. Substrate Condition and Compatibility Report: Submit confirmation that substrate conditions and applied curing agents are acceptable for specified floorcoverings.
   3. Survey Data: Submit floor flatness/floor levelness reports in format described in 01 33 00 at intervals specified in this Section.

1.07 QUALIFICATIONS

A. Concrete Finisher Qualifications: Engage Subcontractors that can coordinate supply and installation of concrete formwork and reinforcing steel, concrete placing and finishing, curing and jointing in a coordinated-source arrangement, and as specified in Section 03 30 00.

B. Floorcovering Installer Qualifications: Engage floorcovering Subcontractors that have at least 5 years experience in installations similar to this project and approved by the product manufacturers to install their products.
   1. Subcontractor’s Responsibility: Perform work of this section in accordance with specified requirements.

1.08 WARRANTY

A. Special Warranty – Concrete Floor Finishing: Submit warranty covering surface deterioration, dusting and cracking for a 2 year period, starting from the date of Substantial Completion of the Work.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Concrete Floor Finishing: Refer to Section 03 30 00 for concrete slab finishing requirements.

B. Applied Finishes Installation: Refer to RELATED REQUIREMENTS associated with applied finishes work.

C. Floorcovering Installation: Install floor preparation materials and floorcoverings products in accordance manufacturer’s written instructions and requirements described in RELATED REQUIREMENTS associated with floorcovering work.

D. Self-Levelling Underlayment Installation: Account for sufficient self-levelling underlayment compounds for improved surface tolerance floors as follows:

1.0 Calculated Effect of Deflection on Floor Flatness (FF)

2.0 Deflection Span Ratio		3.0 Deflection of a 9 metre span		4.0 Final FF Number							
5.0	Initial (FF) – No Deflection			6.0	50	7.0	40	8.0	30	9.0	25
10.0	L/960	11.0	10 mm	12.0	39	13.0	34	14.0	28	15.0	24
16.0	L/480	17.0	19 mm	18.0	25	19.0	23	20.0	21	21.0	19
22.0	L/360	23.0	25 mm	24.0	20	25.0	19	26.0	19	27.0	16
28.0	Calculated Percent Decrease from Optimal Flatness										
29.0	L/960	30.0	10 mm	31.0	24%	32.0	15%	33.0	7%	34.0	4%
35.0	L/480	36.0	19 mm	37.0	51%	38.0	43%	39.0	30%	40.0	24%
41.0	L/360	42.0	25 mm	43.0	61%	44.0	53%	45.0	37%	46.0	36%

1. Calculated Floor Elevation Profile Deviation: Concrete Quantitative Tolerance specified in Section 03 30 00 will change between the time it was first measured (preliminary) and when measurements are taken before floorcoverings and applied finishes are installed (final) as follows:
   a. Slabs-on-Grade: Account for a maximum 20% deviation from measured Concrete Quantitative Tolerance of slabs-on-grade, and include for specified floor levelling products to re-establish Floorcovering Qualitative Tolerance (Straightedge) required by floorcovering manufacturers as a part of Bid Price.
   b. Suspended Slabs: Account for a maximum 25% deviation from measured Concrete Quantitative Tolerance of suspended slabs, and include specified floor levelling products to re-establish Floorcovering Qualitative Tolerance (Straightedge) required by floorcovering manufacturers as a part of Bid Price.
2. Observed Floor Elevation Profile Deviation: Confirm calculations for expected deviation from specified concrete finishing tolerances before application of specified floor levelling products and adjust quantity using unit price allowances submitted with Bid to establish final surface profile required for specified floorcoverings:
   a. Unit price allowance will be used to adjust cost for specified floor levelling products based on the differential between calculated and observed concrete finishing tolerances.
   b. Unit price allowance will be applied as an addition or deduction to floor levelling products included as a part of the Bid Price.

PART 3 EXECUTION

2.01 EXAMINATION

A. Concrete Testing: Refer to Section 03 30 00 for testing associated with concrete quality.

B. Substrate Testing: Refer to Section 09 05 61 for testing associated with moisture emissions, surface porosity and alkalinity, and adhesive compatibility of concrete substrates before installation of floorcovering materials.

C. Concrete Finishing Tolerances Survey: Survey concrete slabs based on concrete finishing tolerances tolerance standards applicable to the work described in individual RELATED REQUIREMENTS:
   1. Concrete Quantitative Tolerance (FF:FL) Measurements: Measure concrete substrate and confirm they meet project requirements specified in Section 03 30 00.
   2. Floorcovering Qualitative Tolerance (Straightedge) Measurements: Measure concrete substrate and confirm they meet project requirements specified in Section 09 05 61.

2.02 PROTECTION

A. Temperature and Humidity Controls during Construction: Contractor will install indirect temporary heating sources for building interior spaces in accordance with the flooring materials Manufacturer's requirements, capable of maintaining consistent and controllable temperature, and maintaining temperature of substrates at a minimum of 3°C above air dew point.

B. Protection of Concrete Substrates: Contractor will protect concrete substrate surfaces during construction to minimize surface contamination and provide a surface that is compatible with floorcovering manufacturers installation tolerances, and correct differential between Concrete Quantitative Tolerance (FF:FL) and Floorcovering Qualitative Tolerance (Straightedge) in accordance with Section 09 05 61, free from alkali, dust and dirt, adhesives, paints and coatings, solvents and oils, grease, wax, form release agents, film forming sealers and curing aids, and film forming hardening compounds that are incompatible with flooring adhesives.

2.03 ALIGNING DIFFERENTIAL TOLERANCES

A. Contractor is responsible for managing coordinated-source concrete placing, finishing and curing of concrete described in this Section in accordance with CSA A23.1, Part 7 and the following:
   1. Contractor will establish control points for floor measurements [and arrange for point cloud surveying] as a component of their QMP provisions to quantify amount of materials required to meet Floorcovering Qualitative Tolerance (Straightedge).
   2. Contractor will manage Subcontractors contributions for site measurements of concrete slabs to establish Concrete Quantitative Tolerance and Floorcovering Qualitative Tolerance (Straightedge).
   3. Contractor will notify Owner, Construction Manager and Architect of differential between calculated concrete finishing tolerances to observed concrete finishing tolerances; Consultant will provide written direction for adjustment to unit price allowance.
   4. Contractor prepares or adds content to their QMP that describes their approach for identifying and correcting deficient work.

B. Subcontractor's Contributions: Subcontractors are responsible for managing surface tolerance requirements contained within their RELATED REQUIREMENTS as follows:
   1. Subcontractor will perform measurement and testing specified in RELATED REQUIREMENTS associated with their work result.
   2. Subcontractor will confirm the Contractor's QMP modifications following pre-construction meetings specified above that they require to achieve specified tolerances.

C. Manufacturers' Contributions: Manufacturers will provide written instructions to Subcontractors identifying product installation requirements including modifications to standard procedures, measurements and testing necessary to achieve specified concrete floor finishing performance requirements.

2.04 SITE QUALITY CONTROL

A. Measurement and Testing: Site quality control requirements are specified in RELATED REQUIREMENTS, and describes measurement and testing responsibilities of Owner, Contractor and Subcontractors.

B. Contractor's Quality Management: QMP will list measurements and testing, and identify Subcontractors responsible for site quality control requirements required to achieve floor finishing performance requirements identified in this Section.

C. Owner's Quality Audit: Owner may engage services of a third-party observation and testing agency to perform quality auditing services necessary to validate Contractor's quality assurance and quality control procedures described in the QMP; scope of service provided by the Owner's quality auditor will be limited to the following:
   1. Quality auditor will notify Owner, Construction Manager and Architect of non-conforming work, irregularities or deficiencies observed during the performance of its services.
   2. Construction Manager and Contractor will discuss options for correction to non-conforming work with Subcontractor responsible for the work to determine appropriate recommendations for correction.
   3. Construction Manager will prepare written communication describing acceptable correction for non-conforming work and issue to the Owner, Contractor and Subcontractors responsible for the work.

4. Quality auditor is not authorized to release, revoke, alter or enlarge requirements of the Contract Documents, make changes to manufacturer's written instructions, nor approve or accept any portion of the Work.
5. Owner's quality auditor will not be permitted to perform any duties of the Construction Manager or Contractor.

2.05 CLOSEOUT ACTIVITIES

A. Cleaning: Keep installed work clean as installation progresses and perform final cleaning as required by Section 01 77 00 Closeout Procedures, coordinated cleaning activities described in RELATED REQUIREMENTS.

B. Demonstration: Provide demonstration and training for Owner's personnel associated with specified floor finishes in accordance with Section 01 92 00 Facility Operation and Maintenance, coordinated with maintenance activities described in RELATED REQUIREMENTS.

END OF SECTION

SECTION 01 91 13
GENERAL COMMISSIONING REQUIREMENTS

PART 1 GENERAL

1.01 SUMMARY

A. This section includes general requirements that apply to the implementation of the Commissioning Process and the contractors' participation in this process. Commissioning is systematic process to provide documented confirmation that the facility's systems are installed in accordance with construction documents, manufacturer's recommendations, perform according to the criteria set forth in the design documents and satisfy the Owner's Project Requirements.

B. This goal is achieved with the process starting during preliminary design phase by documenting the Owner's Project Requirements, the Basis of Design; and continues throughout the construction phase. The process culminates with turnover and Owner Acceptance, achieved through verification of system functional and performance testing.

C. Commissioning during the construction phase is intended to achieve the following specific objectives according to the Contract Documents:
   1. Verify that applicable equipment and systems are installed according to the manufacturer's recommendations and to industry accepted minimum standards and that they receive adequate operational checkout by installing contractors.
   2. Verify and document proper performance of equipment and systems.
   3. Verify that O&M documentation left on site is complete.
   4. Verify that the Owner's operating personnel are adequately trained.

D. The Commissioning Process does not take away from or reduce the responsibility of the system designers or installing contractors to provide a finished and fully functioning facility.

1.02 REFERENCED DOCUMENTS

A. The Owner's Project Requirements (OPR) document.

B. The Basis of Design (BoD) document.

C. The Commissioning Plan – To be provided by IMEG.

D. ASHRAE Standard 202-2013 - Commissioning Process for Buildings and Systems.

1.03 RELATED SECTIONS

A. SECTION 07 08 00 - COMMISSIONING OF THERMAL AND MOISTURE PROTECTION

B. SECTION 08 08 00 - COMMISSIONING OF OPENINGS

C. SECTION 11 08 00 - COMMISSIONING OF EQUIPMENT

D. SECTION 13 08 00 - COMMISSIONING OF SPECIAL CONSTRUCTION

E. SECTION 14 08 00 - COMMISSIONING OF CONVEYING SYSTEMS

F. SECTION 21 08 00 - COMMISSIONING OF FIRE SUPPRESSION SYSTEMS

G. SECTION 22 08 00 - COMMISSIONING OF PLUMBING SYSTEMS

H. SECTION 23 08 00 - COMMISSIONING OF MECHANICAL SYSTEMS

I. SECTION 25 08 00 - COMMISSIONING OF INTEGRATED AUTOMATION SYSTEMS

J. SECTION 26 08 00 - COMMISSIONING OF ELECTRICAL SYSTEMS

K. SECTION 27 08 00 - COMMISSIONING OF COMMUNICATIONS SYSTEMS

L. SECTION 28 08 00 - COMMISSIONING OF SAFETY AND SECURITY SYSTEMS

M. SECTION 33 08 00 - COMMISSIONING OF UTILITIES

1.04 DEFINITIONS

A. Acceptance: A contractually defined action that permits an activity to commence or continue.

B. Basis of Design (BoD): A document that records the concepts, calculations, decisions, and product selections used to meet the Owner's Project Requirements and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.

C. Commissioning Activity: A component of the Commissioning Process.

D. Commissioning Provider (CxP): A person employed by Life Time, or contracted to, who plans, schedules, and coordinates the Commissioning Team to implement the Commissioning Process.

E. Commissioning Technician (CxT): A person employed by, or contracted to, Life Time who executes specific Commissioning Activities, under the direction of the CxP.

F. Commissioning Field Report: A document that records the activities and results of the Commissioning Process.

G. Commissioning Plan (Cx Plan): A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the Commissioning Process.

H. Commissioning Process (Cx): A quality assurance process for enhancing the delivery of a project. The process focuses on verifying and documenting that the facility and all its systems and assemblies are planned, designed, installed, tested, operated, and maintained to meet the Owner's Project Requirements.

I. Commissioning Team: The individuals, who through coordinated actions, are responsible for implementing the Commissioning Process.

J. Construction Documents: This includes a wide range of documents, which will vary from project to project, owner's needs, regulations, codes, and countries. Construction documents usually include the project manual (specifications), plans (drawings) and General terms of the contract, especially those required by subcontractors and vendors, suppliers and manufacturers of equipment, assemblies, and systems.

K. Coordination Drawings: Drawings showing the work of all trades to illustrate that equipment can be installed in the space allocated without compromising equipment function or access for maintenance and replacement. These drawings graphically illustrate and dimension manufacturers' recommended maintenance clearances.

L. Functional Performance Test (FPT): The process of testing system integration using written test procedures. The functional test is performed during the last phase of the project. This is often referred to as a final quality control test, which is done to ensure that design specifications have been incorporated. During testing, how a system responds to changes in setpoints or changes to controlled variables is tested. Functional testing is dynamic testing of the entire system not only its components.

M. Issues Log: A formal and ongoing record of problems or concerns, and their resolution, which have been raised by members of the Commissioning Team during the Commissioning Process.

N. Nominal Group Technique: A formal, structured brainstorming process used to obtain the maximum possible ranked input from a variety of viewpoints in a short period of time. The typical approach is a workshop session where a question is presented, the attendees record their responses individually on a piece of paper, the individual responses are recorded on a flip chart without discussion in a round-robin fashion, all the responses are discussed, and then the individuals rank their top five responses.

O. Owner's Project Requirements (OPR): A written document that details the functional requirements of a project and the expectations of how it will be used and operated. This can include project and design goals, measurable performance criteria, budgets, schedules, success criteria, and supporting information.

P. Pre-Functional Checklist (PFC): A form used by the contractor to verify that appropriate components are on-site, ready for installation, correctly installed, and functional. Pre-functional testing is static testing of components of a system to verify installation and the readiness for Functional testing.

Q. Probabilistic Tools: Tools and methods based upon an estimated, uniform or known probability/statistical distribution of outcome that can be predicted or an underlying outcome

distribution that can be expected or estimated. The distribution of outcome should be within a reasonably close range to the mean expected outcome or measured value, be it known or estimated.

R. Systems Manual: A system-focused composite document that includes the Commissioning Record, operation manual, maintenance manual, and additional information of use to the owner during the Occupancy and Operations Phase.

S. Test Procedure: A written protocol that defines methods, personnel, and expectations for tests conducted on components, equipment, assemblies, systems, and interfaces among systems.

T. Training Plan: A written document that details the expectations, schedule, budget, and deliverables of Commissioning Process activities related to training of project operating and maintenance personnel, users, and occupants.

U. Verification: The process by which specific documents, components, equipment, assemblies, systems, and interfaces among systems are confirmed to comply with the criteria described in the Owner's Project Requirements.

V. Web-based Commissioning Software (WCxS): Cloud-based software that the CxP utilizes to manage the Cx process and the Cx Team.

1.05 COORDINATION

A. Commissioning Team. The members of the commissioning team consist of the Commissioning Provider (CxP), the Owner's Representative (OR), the General Contractor (GC or Contractor), the architect and design engineers (particularly the mechanical engineer), the Mechanical Contractor (MC), the Electrical Contractor (EC), the TAB representative, the Automation Contractor (AC), any other installing subcontractors or suppliers of equipment. If known, the Owner's building or plant operator/engineer is also a member of the commissioning team.

B. Management. The CxP is hired by the Owner directly. The CxP directs and coordinates the commissioning activities. All members work together to fulfill their contracted responsibilities and meet the objectives of the OPR.

C. Scheduling. The CxP will work with the GC according to established protocols to schedule the commissioning activities. The CxP will provide sufficient notice to the GC for scheduling of commissioning related activities. The GC will integrate all commissioning activities into the master schedule. All parties will address scheduling problems and make necessary notifications in a timely manner in order to expedite the commissioning process.

D. The CxP will provide the initial schedule of primary commissioning events at the commissioning scoping meeting. The Commissioning Plan - Construction Phase provides a format for this schedule. As construction progresses more detailed schedules are developed by the CxP. The Commissioning Plan also provides a format for detailed schedules.

1.06 COMMISSIONING PROCESS

A. Commissioning Process. The following narrative provides a brief overview of the typical commissioning tasks during construction and the general order in which they occur.

1. Commissioning during construction begins with a scoping meeting conducted by the CxP where the commissioning process is reviewed with the commissioning team members.
2. Additional meetings will be required throughout construction, scheduled by the CxP with necessary parties attending, to plan, scope, coordinate, schedule future activities and resolve problems.
3. Equipment documentation is submitted to the CxP during normal submittals, including detailed start-up procedures.
4. The CxP reviews startup plans and startup documentation formats provided by the vendors.
5. The CxP provides the Subs with Pre-Functional Checklists to be completed, during the startup process.
6. In general, the checkout and performance verification proceeds from simple to complex; from component level to equipment to systems and inter-system levels with Pre-Functional Checklists being completed before functional testing.

7. The Subs, under the General Contractors direction, execute and document the Pre-Functional Checklists and perform startup and initial checkout. The CxP documents that the checklists and startup were completed according to the approved plans. This may include the CxP witnessing startup of selected equipment.
8. The CxP develops specific equipment and system Functional Performance Test procedures. The Team reviews the procedures.
9. The test procedures are executed by the CxP, with assistance of pertinent Team members.
10. Items of non-compliance in material, installation or setup are corrected and the system is retested.
11. The CxP reviews the O&M documentation for clarity and completeness.
12. Functional Performance Testing is successfully completed before Owner Acceptance is granted.
13. The CxP reviews, approves, and documents the training provided by the Vendors/ Contractors.
14. Deferred testing is scheduled and/or conducted, as required.

1.07 COMMISSIONING TEAM

A. Members Appointed by Contractors: Individuals, each having the authority to act on behalf of the entity they represent, explicitly organized to implement the commissioning process through coordinated action. The commissioning team members shall consist of, but not be limited to, contractors, subcontractors, installers, suppliers, and specialists deemed appropriate by the CxP.

B. Members Appointed by Owner:
1. CxP: The designated person or entity that plans, schedules, and coordinates the commissioning team to implement the commissioning process.
2. Representatives of the facility user and operation and maintenance personnel.
3. The Owners Representative.
4. Architect and engineering design professionals.

1.08 RESPONSIBILITIES

A. Owner: Responsibilities of the Owner include, but are not limited to the following:
1. Provide the OPR documentation to the CxP and General Contractor for information and use.
2. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities.
3. Provide the BoD documentation, prepared by Architect and approved by Owner, to the CxP and Contractor for use in developing the commissioning plan, systems manual, and operation and maintenance training plan.
4. Arrange for facility operating and maintenance personnel to attend various field commissioning activities and field training sessions according to the Commissioning Plan - Construction Phase.
5. Follow the Commissioning Plan.
6. Attend commissioning scoping meetings and additional meetings as necessary.

B. The Owner's Representative OR shall represent the Owner during the commissioning process as follows:
1. Manage the contract of the A/E, and Contractors.
2. Provide final approval for the completion of the commissioning work.
3. Ensure that any seasonal or deferred testing and any deficiency issues are addressed.
4. Follow the Commissioning Plan.
5. Attend commissioning scoping meetings and additional meetings as necessary.

C. Commissioning Provider: Responsibilities of the CxP include, but are not limited to the following:
1. Coordinate and direct each step of the Commissioning Process for systems being commissioned for this project. Coordinate commissioning work schedule with construction Project Manager and/or Contractors.
2. Attend planning and job-site meetings as required to obtain information relating to Commissioning Process.
3. Plan and conduct commissioning scoping and coordination meetings. Provide notice to all Team members to attend scheduled commissioning meetings.

4. Ensure all information required for Commissioning Process from manufacturers, Contractors, and A/E design team is available.
5. Review A/E design documents to gain clear understanding of design intent.
6. Review Contractor submittals for compliance with commissioning needs.
7. Review Contractor process for as-built documentation.
8. Verify that systems and equipment have been installed and started in accordance with manufacturer's recommendations and with generally recognized construction standards and that documentation of such has been provided.
9. Prepare and provide Pre-Functional Checklists to ensure systems have been installed according to project specifications. Verify that Pre-Functional Checklists have been completed by Contractors and are accurate.
10. Prepare and provide Functional Performance Test procedures to demonstrate performance of systems according to project specifications. Observe and document performance of systems, as per process detailed in Functional Test procedures.
11. Review Testing and Balancing (TAB) reports.
12. Decide acceptance or non-acceptance of systems.
13. Arrange for facility operating and maintenance personnel to attend various field commissioning activities and field training sessions.
14. Ensure that seasonal or deferred testing and deficiency issues are addressed.
15. Verify that Operations and Maintenance (O&M) documentation is complete. Operations and Maintenance manuals shall be submitted simultaneously to CxP and to Design Team for review.
16. Verify that Owner training is completed for all systems.
17. Compile and maintain Commissioning Issues Log.
18. Provide Final Commissioning Report.

D. General Contractor: Responsibilities of the GC as relate to the Commissioning Process include, but are not limited to the following:
1. Facilitate the coordination of the commissioning work and incorporate commissioning activities (the Cx Plan) into the overall project schedule.
2. All costs associated with the participation of Contractor, Sub-Contractors, and Equipment Vendors in the Commissioning Process shall be included in the scope of this contract.
3. Attend Commissioning meetings or other meetings called by CxP to facilitate the Commissioning Process.
4. Provide all documentation relating to manufacturer's recommended performance of equipment and systems.
5. Provide Operations and Maintenance Data to CxP for preparation of checklists and test procedures.
6. Review commissioning progress and deficiency reports.
7. Provide Testing and Balancing Report.
8. Assure and facilitate participation and cooperation of subcontractors (electrical, mechanical, automation, fire alarm, etc.) and equipment suppliers as required for the Commissioning Process.
9. Certify to CxP that installation work listed in Pre-Functional Checklists has been completed.
10. Install systems and equipment in strict conformance with project specifications, manufacturer's recommended installation procedures, and Pre-Functional Checklists.
11. Provide copy of vendor completed start-up forms for equipment and systems.
12. Ensure systems have been started and fully checked for proper operation prior to scheduling Functional Performance Testing with CxP.
13. Contractors shall carry out manufacturer's recommended start-up and testing procedures, regardless of whether they are specifically listed in Functional Test procedures.
14. Contractor is not relieved of obligation for systems/equipment demonstration of performance, where a Functional Performance Test is not specifically designated by CxP.
15. Coordinate with CxP to determine mutually acceptable date of Functional Performance Tests.

16. Provide test instruments and communications devices, as prescribed by CxP, required for carrying out Functional Performance Testing of systems.
17. Evaluate and ensure deficiencies shown in the Commissioning Issues Log are corrected within the time allowed for the project.
18. Provide CxP with all submittals, start-up instructions manuals, operating parameters, and other pertinent information related to Commissioning Process.
19. Prepare and submit to CxP Training Program outline for each system.
20. Coordinate and provide training of Owner's personnel.
21. Execute and ensure subcontractors aid with seasonal or deferred Functional Performance Testing witnessed by the CxP.
22. Prepare Operation and Maintenance manuals and As-Built drawings in accordance with specifications; submit copy to CxP in addition to other contractually required submissions.

E. Subcontractors:
1. Prepare and submit to CxP proposed Installation and Startup procedures, to demonstrate performance of systems according to these specifications.
2. Execute Pre-Functional Checklists for appropriate equipment and systems.
3. Provide assistance in equipment testing at the request of the CxP.
4. Attend commissioning meetings as requested by the CxP.
5. Respond to (in writing) and address items documented in the Contractor Commissioning Issues Log.
6. Notify the GC a minimum of two weeks in advance of system start-up and testing, so CxP may be on site to witness.
7. Notify the GC a minimum of two weeks in advance, of the time for start of the TAB work. Attend the initial TAB meeting for review of the TAB procedures.

F. Architect: Responsibilities of the Architect as related to the Commissioning Process shall include, but are not limited to the following:
1. Attend commissioning scoping meeting and other commissioning team meetings as requested by CxP.
2. Perform normal submittal review, construction observation, record drawing preparation, and operations and maintenance data preparation.
3. Provide design narrative documentation requested by CxP.
4. Coordinate resolution of system deficiencies identified during commissioning.
5. Prepare and submit final as-built design intent documentation for inclusion in Operation and Maintenance Manual, and review and approve Operation and Maintenance Manual.
6. Warranty Period: Coordinate resolution of design non-conformance and design deficiencies identified during warranty period commissioning.

G. Mechanical, Electrical, Plumbing, Automation, and Specialty Engineers: Responsibilities of the Engineers as related to the Commissioning Process shall include, but are not limited to the following:
1. Perform detailed submittal review, construction observations, and record drawing preparation.
2. Perform site observation immediately preceding system startup.
3. Provide design narrative and sequence documentation requested by CxP. Assist in clarifying operation and control of commissioned equipment in areas where specifications, control drawings, or equipment documentation are not sufficient for writing detailed testing procedures.
4. Attend commissioning scoping meetings and other commissioning team meetings as requested by CxP.
5. Participate in resolution of system deficiencies identified during commissioning.
6. Prepare and submit final as-built design intent and operating parameters documentation for inclusion in Operation and Maintenance Manual, and review and approve Operation and Maintenance Manual.

1.09 COMMISSIONING DOCUMENTATION

A. General:

1. Timely and accurate documentation of commissioning activities is essential for the commissioning process to be effective. To this end, all commissioning activities conducted by the contractors shall be documented as outlined below and in Part 3 Execution of this specification.
2. Contractor commissioning responsibilities on Web-based Commissioning Software (WCxS) (Such as CxAlloy) include the following items:
    a. Construction Issues.
    b. Pre-Functional Checklists.
    c. Functional Performance Tests.
3. The GC is responsible to review all Construction Commissioning Issues on WCxS with their subcontractors and provide feedback on WCxS in a timely manner.
4. The pre-functional checklists shall be completed by each respective trade contractor involved with the installation of any commissioned systems and equipment.
5. The functional performance tests will be completed by the CxP as they witness the test conducted by the contractors.
6. All Contractor Commissioning Documents prepared by the contractors will be fully completed in a neat and workmanlike manner so as to be fully legible. Documentation which, at the CxP's discretion, is incomplete or less than fully legible shall be deemed unacceptable.
7. Commissioning procedures and tests, which are rejected by the CxP due to incomplete, or illegible contractor documentation shall be repeated by the contractor and new Contractor Commissioning Documents shall be prepared to the Commissioning Team's satisfaction at no additional cost to the Owner.
8. Procedures deemed unacceptable by the Commissioning Team after being repeated due to inadequate documentation may be subject to completion by the CxP, at a cost to the contactor as outlined in item Section 3.10 "Cost of Re-Evaluation" below.
9. All Contractor Commissioning Documents shall be completed on the job-site concurrent with the activities being documented. Remedial documentation of commissioning activities either off-site or after the procedures have been completed is unacceptable.
10. All Contractor Commissioning Documents will be submitted to the CxP for review and acceptance upon completion.

B. Contractor Commissioning Process Status Tracking.
1. Contractors shall be responsible for monitoring the progress of their commissioning activities. The contractor will update the status of issues, checklists and tests on WCxS.
2. The CxP will assist the contractor in using WCxS.
3. The contractors shall regularly update WCxS and upload drawings or pictures as commissioning activities are completed so as to provide a readily available report to CxP regarding current status of the contractors commissioning activities.

C. Record Drawings.
1. Contractors shall regularly update a 'redlined' set of record drawings showing commissioned systems as work is being installed so that the drawings remain current with the field work, and as required in Division 21, 22, 23, 25 and 26 of the project specifications.
2. Redlining record drawings at the end of construction shall not be acceptable.
3. The Contractors up-to-date, in-progress redlines shall be kept on-site in the Contractor's field office and available for review by the Cx Team.

D. Access to Contractor Documentation.
1. Contractors shall provide the CxP with access to shop drawings, coordination drawings, equipment cut-sheets, schematics, in-progress record drawings, manufacturers installation-operation-maintenance manuals, startup reports, etc. to assist the CxP in execution of the Cx process.

PART 2 PRODUCTS

2.01 TEST EQUIPMENT

A. All industry standard test equipment required for performing the specified tests shall be provided by the applicable contractor (as specified) and shall be approved by the CxP. Any proprietary vendor specific test equipment shall be provided by that vendor or manufacturer.

B. Any portable or hand-held setup / calibration devices required to initialize the control system shall be made available by the control vendor (at no cost) to the CxP.

C. The instrumentation used in the commissioning process shall meet the following standards:
   1. Be of sufficient quality and accuracy to test and/or measure system performance within the tolerances required.
   2. Be calibrated at the manufacturer's recommended intervals with calibration tags permanently affixed to the instrument.
   3. Be maintained in good repair and operating condition throughout the duration of use on this project.
   4. Be immediately re-calibrated or repaired if dropped and/or damaged in any way during use on this project.

2.02 BAS HARDWARE AND SOFTWARE

A. Field Panel Software and Hardware:
   1. The BAS Contractor shall furnish the CxP with all hardware and software needed to connect to, communicate with and command the BAS field panels and controllers at no additional charge to the CxP. This hardware and software will be used by the CxP for execution of the commissioning process. Software and hardware provided to the CxP for this purpose, does not include any provisions for use by the Test & Balance Contractor.
   2. Hardware and software covered under this requirement includes, but is not limited to:
      a. Latest versions of proprietary software needed to communicate with BAS field panels and controllers.
      b. Communication modules, software keys, and similar hardware needed for communication from a laptop computer, PDA or similar device to field panels or controllers.
      c. Proprietary cables required for communication between laptop computers or PDAs to field panels or controllers.
      d. Passwords, access levels and similar software permissions necessary for execution of the Cx Process.
      e. Software and hardware manuals for all control system hardware and software provided to the CxP.
   3. This requirement is not meant to include provision of standard hardware such as laptop computers and PDAs nor provision of standard software such as Windows or MS Explorer.
   4. At the conclusion of the Commissioning Process, this hardware and software will be turned over back to the contractor.

B. Operator Workstation Access:
   1. The BAS Contractor shall provide the CxP with software and hardware needed for accessing the BAS' front-end operator workstation(s). At a minimum, this shall include appropriate level user identification names and passwords. Access level shall allow the CxP to fully execute all commissioning procedures and will include the ability to:
      a. View system operation.
      b. Override setpoints.
      c. Command digital and analog output points.
      d. View BAS programming source code (read-only).
      e. View and print graphics.
      f. Create, view, modify, print and download trend logs, histories and reports.

C. Technical Support:

1. The BAS Contractor shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform commissioning activities and demonstrate system operation to assist with completing Functional Performance Test procedures, and seasonal testing as required.

D. Duration of Support:
   1. The BAS Contractor shall provide the CxP with technical support for the duration of the project and through the post occupancy phase commissioning activities and warranty period of the project to support the Cx process. The duration of this support is typically one year after turn over to the owner, to provide time to complete deferred and seasonal testing and the warranty phase activities.

PART 3 EXECUTION

3.01 GENERAL

A. Contractor shall coordinate with subcontractors and equipment vendors to set aside adequate time to address Pre-Functional Checklist execution, Functional Performance Testing, Operations and Maintenance Training, and associated coordination meetings.

B. CxP may also conduct site inspections at critical times and issue Cx Field Reports with observations on installation deficiencies so that they may be addressed by appropriate contractor.

3.02 COMMISSIONING PLAN AND SCHEDULE

A. The CxP shall generate a commissioning plan which identifies Cx tasks, roles and responsibilities for the Cx process. The CxP will submit a Cx schedule for the commissioning process which shall be integrated into the construction schedule by the GC.

3.03 CONSTRUCTION OBSERVATION

A. This is an additional and separate activity from that provided by the design team. Construction observation is required as part of the commissioning and coordination process to be provided by the CxP. Field Observation reports will be distributed through the WCxS.

3.04 COMMISSIONING ISSUES LOGS

A. As part of the commissioning process, all issues will be recorded on the WCxS. The WCxS will divide the issues as follows:
   1. Design Commissioning Issues:
      a. This log is part of the Web-Based Commissioning Software. This log is a formal and ongoing record of issues pertaining to the project construction documents which identifies areas of concern with the design regarding to coordination between divisions, constructability, maintenance clearances, operability or other commissioning concerns. This log specifically separates design issues from contractor issues. The contractor has no responsibility to track or comment on the design team Cx log.
   2. Construction Commissioning Issues:
      a. This log is also a part of the Web-Based Commissioning Software. It is a formal and ongoing record of problems or concerns pertaining to the installation of the commissioned systems and equipment which identifies where the contractors have deviated from the OPR, contract documents, applicable codes or normal industry construction practices. It is the GC's responsibility to regularly login and retrieve this log from the Web-Based Commissioning Software, follow up and review each item on the list with the appropriate trades, and respond to the CxP with feedback within 5 business days from the issuance of the log from the CxP.
      b. Team members will be given access through the WCxS to comment on issues. This is where the GC should provide feedback which includes the following sections:
         1) Response/Action: This is the contractor’s response to the issue identified by the CxP.
         2) Trade: This identifies the specific contractor responsible for the correction of the issue. The issue will be assigned to that contractor or subcontractor.

3) Expected Completion Date: This is the date which the GC and subcontractor agree the issue will be resolved by. This provides information back to the CxP as to when items should be corrected by for spot checking the correction of issues.

c. The GC shall provide feedback and updates to the construction Cx issues log to the CxP within 5 business days from its issuance from the CxP.

d. The CxP will back check a construction issue one (1) time after being told it's complete. If the item is not complete after being told it's complete, the CxP reserves the right to require the GC and associated sub-contractor to accompany the CxP on all future back checks on the project.

e. The CxP will maintain the master Cx log on the WCxS.

3.05 MEETINGS

A. A commissioning team scoping meeting shall be held at a time and place agreed upon shortly after the beginning of the construction phase of the project. Owner, CxP, General Contractor, Architect, Mechanical Contractor, Automation Contractor, and Electrical Contractor shall be present at this meeting. The purpose of the meeting is to familiarize all parties with the requirements of the commissioning process, and to ensure that the responsibilities of each party are clearly understood.

B. Separate meetings including individual equipment suppliers and subcontractors shall be held prior to commissioning of their systems at the discretion of CxP.

C. The CxP shall plan and conduct other meetings as required as construction progresses. Meetings will cover coordination, deficiency resolution, and planning issues with subcontractors. CxP will plan meetings to minimize unnecessary time being spent by subcontractors.

3.06 SYSTEM START-UP

A. Contractors will arrange for start-up of operating equipment and systems prior to scheduling Functional Performance Testing.

B. Start-up of equipment and systems shall be performed only by a manufacturer's representative, or persons who are specifically manufacturer approved. All start-up personnel shall be trained and authorized, experienced and knowledgeable in the operations of such equipment and systems.

C. Coordinate schedule for start-up of various equipment and systems so that sub-systems required for major systems operation are tested first.

D. Manufacturer's start-up reports must be submitted to CxP prior to scheduling Functional Performance Testing.

3.07 PRE-FUNCTIONAL CHECKLISTS (PFC)

A. Pre-Functional Checklists are important to ensure that equipment and systems are properly connected and installed in accordance with specifications, drawings, manufacturer's requirements, and all applicable codes.

B. Checklists shall reside on the WCxS and shall be created by the CxP, for the Contractors to execute.

C. Checklists ensure that functional performance testing may proceed without unnecessary delays.

D. Completion of PFCs shall be executed by the contractors. Only individuals that have direct knowledge and who witnessed that line item task on PFC was performed shall initial item.

E. Each piece of equipment or system a receives PFC form. No sampling strategies are used.

F. PFC for a given system must be successfully completed prior to commencement of Functional Performance Testing of equipment or sub-systems.

G. PFC tasks shall be documented in a checklist format, as prepared and provided by CxP, for each piece of equipment. Each checklist shall be signed by the contractors.

H. CxP provided PFCs shall not preclude Contractor from applying their own construction inspection checklists and quality control.

I. All system elements shall be checked to verify that they have been installed, adjusted, and calibrated properly, that all connections have been made correctly, and that it is ready to function as specified.

J. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, control sequence, and other conditions which may cause damage.

K. Verify that tests, meter readings and specific electrical characteristics agree with those required by equipment or system manufacturer.

L. All discrete elements and sub-systems shall be adjusted and shall be checked for proper operation. Verify wiring and support components for equipment are complete and tested.

M. Conduct start-up procedure recommended by equipment/system manufacturer. Attach a copy of the start-up procedure report as a File to the PFC form on the WCxS.

N. Contractors shall clearly list outstanding items of initial start-up and Pre-Functional Checklists that were not completed successfully at bottom of procedures form or on separate sheet attached to form.

O. Completed forms shall be provided to CxP within 5 days of completion. Installing subcontractor shall correct deficient or incomplete areas in timely manner and shall submit startup reports with statement of correction on original non-compliance report.

3.08 TESTING AND BALANCING

A. Testing, Adjusting, and Balance Contractor (TAB) Requirements:
   1. Air and water balance shall be accomplished by an independent test and balance firm. The test and balance firm shall come back after the final balancing report is approved to work with the CxP and spot check this work to verify accuracy of results. Refer to Division 23 for acceptance criteria.
   2. Test and balance contractor to provide final balancing report to CxP.
   3. The TAB contractor shall be responsible for successful completion and documentation of all TAB activities specified in the Division 23.
   4. Prior to the start of TAB activities, the TAB contractor shall submit a proposed TAB plan, procedures and documentation to the CxP and A/E for review. TAB procedures shall be submitted to allow sufficient time for CxP review and approval prior to the start of TAB activities.
   5. After this review, and prior to start of field work, the TAB contractor will attend one or more planning meetings as required with the Commissioning Team to review and discuss outstanding issues relating to TAB procedures and forms, discuss resolution of issues identified during the TAB contractor's plan review and field inspections, and to coordinate field work.
   6. Prior to the start of fieldwork, the TAB contractor shall issue a final set of TAB procedures and TAB forms which incorporate any comments received during the Commissioning Team review.
   7. The TAB contractor shall have at least one certified field technician on site whenever TAB work is being performed.
   8. The TAB contractor is responsible to notify the GC who in turn shall notify the Commissioning Team a minimum of two (2) weeks in advance of the time for start of TAB work to allow the CxP and A/E time to assess system readiness.
   9. The TAB contractor will work cooperatively with the CxP.
   10. The TAB contractor shall coordinate with the controls contractor to ensure that changes made to the control system during TAB (flow coefficients, duct areas, etc.) are archived and become the default or initial values for these parameters.
   11. The TAB contractor shall provide daily lists of issues and/or problems identified during TAB work to the GC, CxP and A/E for follow-up & resolution with the appropriate contractors.
   12. Participate in verification of the TAB report, which may consist of repeating any selected measurement contained in the TAB report where required by the CxP for verification or diagnostic purposes.
   13. The TAB contractor will provide technicians and instrumentation to support the field verification.
   14. Instruments used for the field verification shall be the same instruments (by model and serial number) that were used for the original TAB work.
   15. Failure of an item during the TAB field verification is defined as:
      a. For all readings other than sound, a deviation of more than 10%.
      b. For sound pressure readings, a deviation of 3 decibels. (Note: variations in background noise will be considered).

16. A failure of more than 10% or 10 (whichever is greater) of the readings tested during the field verification shall result in the rejection of the final TAB report and require re-balancing of the system(s) in question.

3.09 CONTROLS AND INSTRUMENTATION TESTING

A. Testing, Adjusting, and Balance Contractor (TAB) Requirements:
   1. Air and water balance shall be accomplished by an independent test and balance firm. The test and balance firm shall come back after the final balancing report is approved to work with the CxP and spot check this work to verify accuracy of results. Refer to Division 23 for acceptance criteria.
   2. Test and balance contractor to provide final balancing report to CxP.
   3. The TAB contractor shall be responsible for successful completion and documentation of all TAB activities specified in the Division 23.
   4. Prior to the start of TAB activities, the TAB contractor shall submit a proposed TAB plan, procedures and documentation to the CxP and A/E for review. TAB procedures shall be submitted to allow sufficient time for CxP review and approval prior to the start of TAB activities.
   5. After this review, and prior to start of field work, the TAB contractor will attend one or more planning meetings as required with the Commissioning Team to review and discuss outstanding issues relating to TAB procedures and forms, discuss resolution of issues identified during the TAB contractor's plan review and field inspections, and to coordinate field work.
   6. Prior to the start of fieldwork, the TAB contractor shall issue a final set of TAB procedures and TAB forms which incorporate any comments received during the Commissioning Team review.
   7. The TAB contractor shall have at least one certified field technician on site whenever TAB work is being performed.
   8. The TAB contractor is responsible to notify the GC who in turn shall notify the Commissioning Team a minimum of two (2) weeks in advance of the time for start of TAB work to allow the CxP and A/E time to assess system readiness.
   9. The TAB contractor will work cooperatively with the CxP.
   10. The TAB contractor shall coordinate with the controls contractor to ensure that changes made to the control system during TAB (flow coefficients, duct areas, etc.) are archived and become the default or initial values for these parameters.
   11. The TAB contractor shall provide daily lists of issues and/or problems identified during TAB work to the GC, CxP and A/E for follow-up & resolution with the appropriate contractors.
   12. Participate in verification of the TAB report, which may consist of repeating any selected measurement contained in the TAB report where required by the CxP for verification or diagnostic purposes.
   13. The TAB contractor will provide technicians and instrumentation to support the field verification.
   14. Instruments used for the field verification shall be the same instruments (by model and serial number) that were used for the original TAB work.
   15. Failure of an item during the TAB field verification is defined as:
       a. For all readings other than sound, a deviation of more than 10%.
   16. A failure of more than 10% or 10 (whichever is greater) of the readings tested during the field verification shall result in the rejection of the final TAB report and require re-balancing of the system(s) in question.

3.10 FUNCTIONAL PERFORMANCE TESTS (FPT)

A. The objective of testing is to demonstrate that each system is operating according to documented design intent and Contract Documents, through all possible modes of operation.

B. Test forms shall reside on WCxS and shall be created by the CxP, for the CxP to execute, with assistance from the Contractors.

C. Contractor shall bear all costs associated with participation in the execution of testing procedures for all items listed in Part 3 of the related specifications.

D. Testing is intended to begin upon completion of each system. Testing may proceed prior to completion of systems or sub-systems at the discretion of CxP. Initiation of system testing, before

completion, does not relieve Contractor from fully completing system, including Pre-Functional Checklist execution, as early as possible.

E. Testing shall be conducted under specified operating conditions as recommended or approved by CxP.

F. A separate test shall be performed on each complete system. Each function shall be demonstrated to the satisfaction of CxP in accordance with proposed test procedures developed to demonstrate compliance with specifications.

G. Each test shall be witnessed and signed off by CxP upon satisfactory completion.

H. All elements of system shall be tested to demonstrate that total systems satisfy all requirements of these specifications. Testing shall be accomplished on hierarchical basis. Test each piece of equipment for proper operation, followed by each subsystem, followed by the entire system, followed by any inter-ties to other major systems.

I. All major testing materials and equipment shall be provided by contractor.
   1. Notify CxP, in writing, of request for scheduling Functional Performance Testing. Submit request no fewer than five (5) business days prior to desired day of testing.
   2. Contractor must certify that systems and equipment are functioning satisfactorily, according to specifications and design intent, prior to requesting testing. Upon receipt of such certification, CxP will schedule with Contractor a time for the particular system test.
   3. CxP will attempt to schedule testing when convenient for Contractor and its vendors, and to minimize lost time to Contractor.
   4. Contractor will resolve all deficiencies identified during initial test prior to submitting request, in writing, for re-testing. Such request for re-testing shall certify that Contractor has resolved all deficiencies, or list reason why any deficiencies remain which cannot be resolved.
   5. CxP will re-test to ensure that all deficiencies have been resolved.
   6. Deficiencies that were not detected in first Test, but are discovered in subsequent re-testing, are to be resolved by Contractor as if they had been discovered in initial testing.

J. Functional Performance Testing Requirements and Procedures:
   1. To facilitate Testing, Contractors shall provide personnel to accompany CxP as requested for Testing, including any follow-up testing. Such personnel must be experienced, qualified, and intimately familiar with the system being tested.
      a. Participation by representatives of the Automation contractor is of particular importance in Testing. All systems which are controlled and / or monitored by the IAS are to be thoroughly tested, point by point, through all modes of operation, with the assistance of the Contractor's representative. Graphics, setpoints, and programming are to be included as a part of Functional Testing as well.
      b. Contractors must provide personnel to accompany CxP for equipment and systems which may pose health and safety concerns, such as steam boilers.
      c. Should they fail to provide a representative to accompany CxP as requested during Testing, Contractor continues to bear full responsibility for equipment warranty.
   2. Each system shall be operated through all modes of operation including, but not limited to seasonal, occupied, unoccupied, warm-up, cool-down, part-load, and full-load, where system response is specified.
      a. For multiple units, sampling strategy established by CxP may be used.
      b. Verification of each sequence in Sequence of Operations is required.
      c. Proper responses to such modes and conditions as power failure, freeze condition, low oil pressure, no flow, equipment failure, and the like, shall also be tested.
   3. Testing is to be dedicated solely to testing of equipment and systems, and not to resolution of deficiencies. Deficiencies identified during testing process must be corrected by Contractor at a time other than during Testing.
   4. CxP shall issue test reports with readings and checklists and a listing of any deficiencies that must be addressed by Contractor or Subcontractors.

5. CxP shall submit a Final Report recommending acceptance or non-acceptance of individual system components as well as the systems as a whole.

K. Re-Testing and Failure to Remedy Deficiencies:
   1. It is expected that some deficiencies will be found during initial inspection and during Testing; such deficiencies are expected to be minimal.
   2. It is the Contractor's responsibility to remedy identified deficiencies, both in Pre-Functional and in Functional Testing phases of work, in a timely and thorough manner.
   3. It is the Contractor's responsibility to ensure that all deficiencies are corrected prior to requesting a re-inspection or re-test of systems and equipment. Do not request re-inspection or re-test until deficiencies are corrected.
   4. CxP may agree to re-testing systems or equipment where deficiencies remain, which are beyond Contractor's control to resolve expeditiously.
   5. CxP will carry out a second re-inspection or re-test of systems and equipment subsequent to receiving Contractor's request.

3.11 COST OF RE-EVALUATION

A. The cost for Contractors to re-evaluate any Commissioning Procedure due to open issues shall be borne by the contractors.

B. The CxP will be available for two attempts of the Functional Performance Tests (one initial and one re-try) with minimal follow-up where necessary (due to deficiencies, systems not ready, incomplete work, etc.) to try to accomplish each test as part of the contract. When additional work is required because systems are not ready or because they do not successfully pass the FPT after they have been indicated as ready, the contractor will be charged for the CxP's additional ++retesting costs. Additional fees will be paid to the CxP by the Owner and shall be reimbursed by the Contractor.

C. Any required re-testing by any contractor shall not be allowed as a justified reason for a claim of delay or for a time extension by the contractor.

3.12 OPERATION AND MAINTENANCE (O&M) MANUALS

A. The CxP shall review the draft form of the O&M manuals provided by the trade contractors with commissioning scope. The review process shall verify that O&M instructions meet specifications and are included for all equipment furnished by the contractor, and that the instructions and wiring diagrams are project specific (edited where necessary) to the actual equipment provided for this project.

B. Published literature shall be specifically oriented to the provided equipment indicating required operation and maintenance procedures, parts lists, assembly/disassembly diagrams, and related information.

C. The contractor shall incorporate the standard technical literature into system specific formats for this facility as designed and as actually installed. The resulting O&M information shall be project and system specific, concise, to the point, and tailored specifically to this facility.

D. The O&M manual review, and coordination efforts MUST be completed prior to Owner training sessions, as these documents are to be utilized in the training sessions.

E. In addition to the O&M manual requirements within other specification sections the O&M manuals shall include at a minimum the following:
   1. An equipment data sheet with the equipment name tag, model#, serial # and any other relevant information for the equipment for entry into the Owner's central maintenance management system (CMMS).
      a. The format of the data entry sheets will be provided by the owner and/or CxP.
      b. Data entry of the equipment information into the CMMS will be the responsibility of the owner.
   2. A copy of the approved submittal, indicating the exact make and model of the equipment installed.
   3. A copy of the manufacturer's IOM manual.
   4. A copy of all warranties.

3.13 TRAINING

A. Scheduling:
   1. Provide a proposed schedule and outline of training of Owner's personnel for CxP review approximately 30 days before project completion.
   2. Submit revised outline and fully developed training materials for review by CxP, 10 business days prior to scheduled training sessions.
   3. Organize training to fit Owner's schedule and to optimize the learning experience. Limit continuous sessions to no more than three hours at a time.
   4. All training eents shall be video recorded and provided to the GC for closeout turnover.

B. Training Materials:
   1. Develop Training Manuals to meet requirements of individual equipment specification sections.
   2. Operating and Maintenance Manuals alone are NOT considered training manuals. O&M Manuals may be used as reference but shall not be considered to meet requirements for training materials.
   3. Develop a detailed outline showing how training program will be organized, including classroom and hands-on training as required by individual specifications sections.
   4. Provide with training materials, a quick reference "how-to" index which will allow operators to easily access information included in Training Manuals and/or O&M Manuals. This reference will include, as a minimum, routine normal operating instructions and sequences. Include regulation, control, stopping, shutdown, and emergency instructions.
   5. Refer to individual equipment or system specifications for minimum material to be covered as part of the training program.

3.14 SYSTEMS TO BE COMMISSIONED

A. GENERAL:
   1. The following outline of commissioning requirements by Division is provided as a guideline for Contractor, sub-contractors, and CxP to understand the nature and extent of commissioning work, so that resources may be properly allocated.
   2. Commissioning specifications supplement requirements of individual specifications sections but shall not be interpreted to replace or diminish the specified scope of any individual section.
   3. For all sections listed below, Contractor and Subcontractors shall comply with all commissioning requirements specified.
   4. Although listed separately, systems listed below shall be commissioned as a part of another system, as determined by the CxP.

B. APPLICABLE SYSTEMS
   1. Division 07 - Thermal and Moisture Protection:
      a. For a list of Commissioned Systems, refer to Section 07 08 00.
   2. Division 08 - Openings:
      a. For a list of Commissioned Systems, refer to Section 08 08 00.
   3. Division 11 - Equipment:
      a. For a list of Commissioned Systems, refer to Section 11 08 00.
   4. Division 13 - Special Construction:
      a. For a list of Commissioned Systems, refer to Section 13 08 00.
   5. Division 14 - Conveying Systems:
      a. For a list of Commissioned Systems, refer to Section 14 08 00.
   6. Division 21 - Fire Suppression Systems:
      a. For a list of Commissioned Systems, refer to Section 21 08 00.
   7. Division 22 - Plumbing Systems:
      a. For a list of Commissioned Systems, refer to Section 22 08 00.
   8. Division 23 - Mechanical Systems:
      a. For a list of Commissioned Systems, refer to Section 23 08 00.
   9. Division 25 - Integrated Automation:
      a. For a list of Commissioned Systems, refer to Section 25 08 00.

10. Division 26 - Electrical Systems:
    a. For a list of Commissioned Systems, refer to Section 26 08 00.
11. Division 27 - Communications Systems:
    a. For a list of Commissioned Systems, refer to Section 27 08 00.
12. Division 28 - Safety and Security Systems:
    a. For a list of Commissioned Systems, refer to Section 28 08 00.
13. Division 33 - Utilities:
    a. For a list of Commissioned Systems, refer to Section 33 08 00.

3.15 EXCLUSIONS

A. Responsibility for construction means and methods: The CxP is not responsible for construction means, methods, job safety, or any construction management functions on the job site.

B. Hands-on work by the CxP: The contractors shall provide all services requiring tools or the use of tools to start-up, test, adjust, or otherwise bring equipment and systems into a fully operational state. The CxP shall coordinate and observe these procedures (and may make minor adjustments), but shall not perform construction or technician services other than verification of testing, adjusting, balancing, and control functions.

3.16 COMMISSIONING PLAN

PROVIDED BY IMEG

END OF SECTION

SECTION 01 92 00

FACILITY OPERATION AND MAINTENANCE

PART 1 GENERAL

1.01 SUBMITTAL REQUIREMENTS

A. Submittal of Operation and Maintenance Data shall follow the procedures specified in Section 01 33 00 Submittal Procedures.
   1. Operation and Maintenance Data shall be reviewed by the owner and will be returned for revision if incomplete or incorrectly formatted.

B. Operations and Maintenance Manual:
   1. The Contractor shall compile O&M manuals for every piece of equipment/system with the following format:
      a. Format: All documents shall be submitted in their native digital format.
         1) Drawings shall be VISIO or AutoCAD format.
         2) All other documents shall be in the Portable Document Format (PDF). PDFs shall be native, no scans, and OCR searchable.
         3) The O&M in its entirety shall be turned over to Operations on a portable memory device.
      b. There shall be separate files for each document, with a hyperlink from the Table of Contents.
      c. There shall be a title page and a table of contents in the front of each “binder”. In each binder, there shall be a main tab for each specification section. Behind the section number tab there shall be the equipment ID tag sub-tab for each piece of equipment. These sub-tabs shall match the specification numbers. Behind each equipment name tab shall be the following sections, in the given order, labeled with the title of the section.
         1) Contractor. The first page behind the equipment tab shall contain the name, address and telephone number of the manufacturer and installing contractor and the 24-hour number for emergency service for all equipment in this section, identified by equipment.
         2) Submittal and Product Data. This section shall include all approved submittal data, cut sheets and appropriate shop drawings. If submittal was not required for approval, descriptive product data shall be included.
         3) Model/Serial number. All items installed shall be identified by model and serial number, if applicable.
         4) Operation and Maintenance Instructions. These shall be the written manufacturer’s data with the model and features of this installation clearly marked and edited to omit reference to products or data not applicable to this installation. This section shall include data on the following:
            (a) Installation, startup and break-in instructions.
            (b) All starting, normal shutdown, emergency shutdown, manual operation, seasonal changeover and normal operating procedures and data, including any special limitations.
            (c) O&M and installation instructions that were shipped with the unit.
            (d) Preventative maintenance and service procedures and schedules.
            (e) Troubleshooting procedures.
            (f) A parts list, edited to omit reference to items which do not apply to this installation.
            (g) A list of any special tools required to service or maintain the equipment.
            (h) Performance data, ratings and curves.
            (i) Warranty, which clearly lists conditions to be maintained to keep warranty in effect and conditions that would affect the validity of the warranty.
            (j) Any service contracts issued.

5) Supplemental Data. Prepare text and/or special drawings to provide necessary information, where manufacturer's standard printed data is not available and information is necessary for a proper understanding and operation and maintenance of equipment or systems, or where it is necessary to provide additional information to supplement data included in the manual or project documents.
6) Automation Drawings. Include the diagrams for all equipment and its components, including the sequence of operations. This section will be provided by the Division 25 contractor.

d. Test and Balance (TAB) Report: The TAB Contractor has specific TAB Report requirements, detailed in Section 23 05 93, that shall be included in this section.
e. Design Architect and Engineers' Calculations: The Architects and Engineers have project specific design data that shall be included in this manual.

2. Commissioning Manual.
a. Refer to O&M documentation requirements identified in this section, in Section 01 91 13 and other Commissioning specific sections.
b. Commissioning Report and Testing Data. Compile a separate manual dedicated to documenting the Commissioning Process which will include all verification and testing data.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 03 2000
CONCRETE REINFORCEMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Reinforcing bars, welded wire reinforcement and supplementary or miscellaneous items, and devices incidental to general use of reinforcing steel for concrete.

B. Testing of reinforcing steel welding shall be performed by Owner's testing agency at Owner's expense.

1.02 RELATED SECTIONS

A. Section 01 33 00 - Submittal Procedures.

B. Section 01 40 00 - Quality Requirements.

C. Section 01 45 33 - Code-Required Special Inspections and Procedures.

D. Section 01 60 00 - Product Requirements.

E. Section 03 30 00 - Cast-in-Place Concrete.

F. Section 03 38 00 - Post-Tensioned Concrete.

G. Section 03 45 70 - Architectural Site Cast Concrete Wall Panels.

1.03 REFERENCE STANDARDS

A. CRSI (DA4) Concrete Reinforcing Steel Institute; Manual of Standard Practice.

B. ACI 301 American Concrete Institute; Specifications for Structural Concrete.

C. ACI SP-66 American Concrete Institute; Detailing Manual.

D. ASTM A36/A36M Standard Specification for Carbon Structural Steel.

E. ASTM A615/A615M Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.

F. ASTM A663A/A663M Standard Specification for Steel Bars, Carbon, Merchant Quality, Mechanical Properties.

G. ASTM A706/A706M Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement.

H. ASTM A1064/A1064M Standard Specification for Carbon-Steel Wire and Welded Wire.

I. ASTM C1116/C1116M Standard Specification for Fiber-Reinforced Concrete.

J. AWS D1.4/D1.4M American Welding Society. Structural Welding Code - Reinforcing Steel

1.04 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Perform concrete reinforcement work in accordance with CRSI Manual of Standard Practice, and CRSI Documents 63 and 65.

C. Conform to ACI 301 and ACI SP- 66.

1.05 SUBMITTALS

A. Material and Equipment Submittals: Submit the following under provisions of Section 01 33 00 - Submittals:

1. Shop Drawings: Provide a placing plan indicating applicable details. Indicate sizes, spacing, location and quantities of reinforcing steel, bending and cutting schedules, splicing locations and lap lengths, stirrup spacing, supporting and spacing devices and placing tolerances.
    a. Shop drawings shall contain sufficient information to properly place all reinforcement.

b. Any changes or deviations from the contract documents shall be clouded and clearly identified on the shop drawings.
c. Clearly indicate if the shop drawings are being performed in phases and identify any items not included.
d. Slab-on-grade and slab-on-metal deck reinforcing shop drawings shall be submitted concurrently with related control/construction joint plans. See specification section 03 30 00 Cast-in-Place Concrete for additional information.

2. Procurement:
a. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
b. Submit inventory to Owner within 5 days of delivery of materials.
c. See Sections 01 33 00 and 01 60 00.

B. Perform and submit reports of Code Required Special Inspections as required in Section 01 45 33.

PART 2 PRODUCTS

2.01 MATERIALS

A. Reinforcing Steel: ASTM A615/A615M, 60 ksi yield grade billet-steel and deformed bars, uncoated finish.

B. Smooth Bar Dowels: ASTM A663/A663M, grade 60, round.

C. Slab on Ground Plate Dowels: Plate material shall be ASTM A36 steel and shall be Diamond Dowel System, by PNA Construction Technologies, size 1/4” x 4½ ” dowels. Locate plate dowels at construction joints. Do not shear plates. Remove burrs at edges of plates.

D. Contraction Joint Protection: Load plate shall be smooth steel plate bars, ASTM A36, and shall be Load Plate Basket or PD3 Basket by PNA Construction Technologies. Locate Load Plate Baskets at contraction joints so noted on the plans. Do not shear. Remove burrs.

E. Welded Steel Wire Fabric: ASTM A1064/A1064M plain type.

F. Steel Wire: ASTM A1064/A1064M, plain, cold drawn steel.

G. Welded Reinforcing: ASTM A706/A706M.

H. Monofilament, self-fibrillating, structural fibers meeting ASTM C1116/C1116M. See Specification Section 03 30 00 Cast-In-Place Concrete for more information.

2.02 ACCESSORY MATERIALS

A. Tie Wire: Conform to CRSI recommendations.

B. Chairs, Bolsters, Bar Supports, and Spacers: Sized and spaced for strength and support of reinforcement during installation and placement of concrete; including load bearing pad on bottom to prevent vapor barrier puncture.

C. Chairs, Bolsters, Bar Supports, Spacers Adjacent to Architectural Concrete Surfaces: Plastic coated or stainless steel type; sized and shaped as required.

2.03 FABRICATION

A. Fabricate in accordance with ACI SP-66, providing concrete cover specified in Section 03 30 00 - Cast-in-Place Concrete.

B. Locate reinforcing splices not indicated on Drawings at points of minimum stress. Indicate location of splices on Shop Drawings.

C. Weld reinforcing bars per AWS D1.4/D1.4M.

PART 3 EXECUTION

3.01 INSTALLATION

A. Before placing concrete, clean reinforcement of foreign particles or coatings.

B. Place, support, and secure reinforcement against displacement. Do not deviate from alignment or measurement.

C. Do not displace or damage vapor barrier required by Section 03 30 00 - Cast-in-Place Concrete.

D. Place reinforcement to obtain minimum coverages for concrete protection as specified in Section 03 30 00 - Cast-in-Place Concrete.

E. Install welded steel wire fabric in as long lengths as practicable. Lap adjoining pieces at least two full square and lace splices with wire. Offset end laps in adjacent widths to prevent continuous laps in either direction. Mesh shall be chaired in place prior to pour.

3.02 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed.

B. Special Structural Testing and Inspection Services: Structural Testing and Inspection shall be performed by qualified parties as specified herein. Include items required by the Currently adopted IBC Section 1705.3 and per Section 01 45 33, and other items which in professional judgment of Structural Engineer of Record, are critical to integrity of building structure.

C. Reinforcing Placement: A special inspector shall inspect placement of reinforcing for all concrete work scheduled for reinforcing prior to concrete placement.

END OF SECTION

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SECTION 03 20 00
CONCRETE REINFORCEMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Reinforcing bars, welded wire reinforcement and supplementary or miscellaneous items, and devices incidental to general use of reinforcing steel for concrete.

B. Testing of reinforcing steel welding shall be performed by Owner's testing agency at Owner's expense.

1.02 RELATED SECTIONS

A. Section 01 33 00 - Submittal Procedures.

B. Section 01 40 00 - Quality Requirements.

C. Section 01 45 33 - Code-Required Special Inspections and Procedures.

D. Section 01 60 00 - Product Requirements.

E. Section 03 30 00 - Cast-in-Place Concrete.

F. Section 03 38 00 - Post-Tensioned Concrete.

G. Section 03 45 70 - Architectural Site Cast Concrete Wall Panels.

1.03 REFERENCE STANDARDS

A. CRSI (DA4) Concrete Reinforcing Steel Institute; Manual of Standard Practice.

B. ACI 301 American Concrete Institute; Specifications for Structural Concrete.

C. ACI SP-66 American Concrete Institute; Detailing Manual.

D. ASTM A36/A36M Standard Specification for Carbon Structural Steel.

E. ASTM A615/A615M Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.

F. ASTM A663A/A663M Standard Specification for Steel Bars, Carbon, Merchant Quality, Mechanical Properties.

G. ASTM A706/A706M Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement.

H. ASTM A1064/A1064M Standard Specification for Carbon-Steel Wire and Welded Wire.

I. ASTM C1116/C1116M Standard Specification for Fiber-Reinforced Concrete.

J. AWS D1.4/D1.4M American Welding Society. Structural Welding Code - Reinforcing Steel

1.04 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Perform concrete reinforcement work in accordance with CRSI Manual of Standard Practice, and CRSI Documents 63 and 65.

C. Conform to ACI 301 and ACI SP- 66.

1.05 SUBMITTALS

A. Material and Equipment Submittals: Submit the following under provisions of Section 01 33 00 - Submittals:

1. Shop Drawings: Provide a placing plan indicating applicable details. Indicate sizes, spacing, location and quantities of reinforcing steel, bending and cutting schedules, splicing locations and lap lengths, stirrup spacing, supporting and spacing devices and placing tolerances.
    a. Shop drawings shall contain sufficient information to properly place all reinforcement.

b. Any changes or deviations from the contract documents shall be clouded and clearly identified on the shop drawings.
c. Clearly indicate if the shop drawings are being performed in phases and identify any items not included.
d. Slab-on-grade and slab-on-metal deck reinforcing shop drawings shall be submitted concurrently with related control/construction joint plans. See specification section 03 30 00 Cast-in-Place Concrete for additional information.

2. Procurement:
a. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
b. Submit inventory to Owner within 5 days of delivery of materials.
c. See Sections 01 33 00 and 01 60 00.

B. Perform and submit reports of Code Required Special Inspections as required in Section 01 45 33.

PART 2 PRODUCTS

2.01 MATERIALS

A. Reinforcing Steel: ASTM A615/A615M, 60 ksi yield grade billet-steel and deformed bars, uncoated finish.

B. Smooth Bar Dowels: ASTM A663/A663M, grade 60, round.

C. Slab on Ground Plate Dowels: Plate material shall be ASTM A36 steel and shall be Diamond Dowel System, by PNA Construction Technologies, size 1/4" x 4½ " dowels. Locate plate dowels at construction joints. Do not shear plates. Remove burrs at edges of plates.

D. Contraction Joint Protection: Load plate shall be smooth steel plate bars, ASTM A36, and shall be Load Plate Basket or PD3 Basket by PNA Construction Technologies. Locate Load Plate Baskets at contraction joints so noted on the plans. Do not shear. Remove burrs.

E. Welded Steel Wire Fabric: ASTM A1064/A1064M plain type.

F. Steel Wire: ASTM A1064/A1064M, plain, cold drawn steel.

G. Welded Reinforcing: ASTM A706/A706M.

H. Monofilament, self-fibrillating, structural fibers meeting ASTM C1116/C1116M. See Specification Section 03 30 00 Cast-In-Place Concrete for more information.

2.02 ACCESSORY MATERIALS

A. Tie Wire: Conform to CRSI recommendations.

B. Chairs, Bolsters, Bar Supports, and Spacers: Sized and spaced for strength and support of reinforcement during installation and placement of concrete; including load bearing pad on bottom to prevent vapor barrier puncture.

C. Chairs, Bolsters, Bar Supports, Spacers Adjacent to Architectural Concrete Surfaces: Plastic coated or stainless steel type; sized and shaped as required.

2.03 FABRICATION

A. Fabricate in accordance with ACI SP-66, providing concrete cover specified in Section 03 30 00 - Cast-in-Place Concrete.

B. Locate reinforcing splices not indicated on Drawings at points of minimum stress. Indicate location of splices on Shop Drawings.

C. Weld reinforcing bars per AWS D1.4/D1.4M.

PART 3 EXECUTION

3.01 INSTALLATION

A. Before placing concrete, clean reinforcement of foreign particles or coatings.

B. Place, support, and secure reinforcement against displacement. Do not deviate from alignment or measurement.

C. Do not displace or damage vapor barrier required by Section 03 30 00 - Cast-in-Place Concrete.

D. Place reinforcement to obtain minimum coverages for concrete protection as specified in Section 03 30 00 - Cast-in-Place Concrete.

E. Install welded steel wire fabric in as long lengths as practicable. Lap adjoining pieces at least two full square and lace splices with wire. Offset end laps in adjacent widths to prevent continuous laps in either direction. Mesh shall be chaired in place prior to pour.

3.02 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed.

B. Special Structural Testing and Inspection Services: Structural Testing and Inspection shall be performed by qualified parties as specified herein. Include items required by the Currently adopted IBC Section 1705.3 and per Section 01 45 33, and other items which in professional judgment of Structural Engineer of Record, are critical to integrity of building structure.

C. Reinforcing Placement: A special inspector shall inspect placement of reinforcing for all concrete work scheduled for reinforcing prior to concrete placement.

END OF SECTION

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SECTION 03 3000
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Formwork, shoring, bracing, anchorage, inserts, embedded items, and openings.
   2. Form accessories.
   3. Drain tile.
   4. Perimeter Foundation Insulation.
   5. Cast-in-place concrete.
   6. Stripping forms.
   7. Concrete curing materials and methods.
   8. Concrete sealer and slip-resistant finish coatings.
   9. Accessories.

1.02 SYSTEM DESCRIPTION

A. Formwork: Design, engineer and construct formwork, shoring and bracing to meet design and code requirements, so that resultant concrete conforms to required shapes, lines, and dimensions; and that formwork is able to support vertical and lateral loads until such loads can be supported by concrete structure.

1.03 RELATED SECTIONS

A. Section 01 33 00 - Submittal Procedures.
B. Section 01 40 00 - Quality Requirements.
C. Section 01 45 33 - Code-Required Special Inspections and Procedures.
D. Section 01 60 00 - Product Requirements.
E. Section 01 84 21 - Interior Concrete Floor Finishing Performance Requirements.
F. Section 03 20 00 - Concrete Reinforcement.
G. Section 03 38 00 - Post Tensioned Concrete.
H. Section 03 45 70 - Architectural Site Cast Concrete Wall Panels.
I. Section 05 31 00 - Steel Decking.
J. Section 05 51 00 - Metal Stairs.
K. Section 07 14 50 - Fluid Applied Waterproofing Membrane.
L. Section 07 27 26 - Fluid Applied Membrane Air Barriers.
M. Section 07 27 27 - Fluid Applied Vapor-Impermeable Air Barriers.
N. Section 07 53 23 - Ethylene-Propylene-Diene-Monomer (EPDM) Roofing.
O. Section 07 54 23 - Thermoplastic Polyolefin (TPO) Roofing.
P. Section 09 05 61 - Common Work Results for Flooring Preparation.
Q. Section 13 48 13 - Manufactured Sound and Vibration Control Components.
R. Section 32 13 13 - Concrete Paving.

1.04 REFERENCE STANDARDS

A. AASHTO M182 Standard Specification for burlap.
B. AASHTO T318 Standard Method of Test for Water Content of Freshly Mixed Concrete.
C. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials.
D. ACI 207.1 - Guide to Mass Concrete
E. ACI 301-20 American Concrete Institute; Specifications for Concrete Construction.

F. ACI 305 - Hot Weather Concreting.

G. ACI 306.1 - Standard Specification for Cold Weather Concreting.

H. ACI 308.1 - Standard Specification for Curing Concrete.

I. ACI 318-19 (22) American Concrete Institute; Building Code Requirements for Structural Concrete and Commentary.

J. ADAAG Americans with Disabilites Act Accessibility Guidelines.

K. ASTM C31/C31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field.

L. ASTM C33/C33M Standard Specification for Concrete Aggregates.

M. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.

N. ASTM C42/C42M Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.

O. ASTM C94/C94M Standard Specification for Ready-Mixed Concrete.

P. ASTM C138/C138M Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete.

Q. ASTM C143/143M Standard Test Method for Slump of Hydraulic-Cement Concrete

R. ASTM C150/C150M Standard Specification for Portland Cement.

S. ASTM C157/C157M Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete.

T. ASTM C171 Standard Specification for Sheet Materials for Curing Concrete.

U. ASTM C172 - Standard Practice for Sampling Freshly Mixed Concrete.

V. ASTM C173/C173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.

W. ASTM C231/C231M Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.

X. ASTM C260/C260M Standard Specification for Air-Entraining Admixtures for Concrete.

Y. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.

Z. ASTM C330 - Standard Specification for Lightweight Aggregates for Structural Concrete.

AA. ASTM C494/C494M Standard Specification for Chemical Admixtures for Concrete.

BB. ASTM C595/595M Standard Specification for Blended Hydraulic Cements

CC. ASTM C618 Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.

DD. ASTM C685/C685M - Standard Specification for Concrete Made By Volumetric Batching and Continuous Mixing.

EE. ASTM C881/C881M Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.

FF. ASTM C989/C989M Standard Specification for Slag Cement for Use in Concrete and Mortars.

GG. ASTM C1064/C1064M - Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.

HH. ASTM C1107/C1107M Standard Specification for Packaged Dry, Hydraulic-Cement Grout.

II. ASTM C1116/C1116M Standard Specification for Fiber-Reinforced Concrete.

JJ. ASTM C1157 - Standard Performance Specification for Hydraulic Cement.

KK. ASTM C1218/C1218M - Standard Test Method for Water-Soluble Chloride in Mortar and Concrete.

LL. ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures.

MM. ASTM D994 - Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).

NN. ASTM D1751 Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).

OO. ASTM D2047 Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method.

PP. ASTM D2103 - Standard Specification for Polyethylene Film and Sheeting.

QQ. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials.

RR. ASTM E1155 Standard Test Method for Determining F(F) Floor Flatness and F(L).

SS. ASTM E1643 Standard Practice for Selection, Design, Installation and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.

TT. ASTM E1745 Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.

1.05 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. See Section 01 84 21 for additional quality requirements for concrete floors and floor substrates.

C. Maintain copy of ACI 301 on site.

D. Employ an independent testing laboratory to test proposed aggregate and design concrete mixes for each type of concrete required.

E. Design concrete mix proportions on basis of field experience and/or trial mix design in accordance with ACI 301. If historical data is used, accompany mix designs with complete standard deviation analysis.

F. Cast-In-Place Concrete: Obtain materials from the same source throughout the Work.

G. Formwork: Design, engineer and construct formwork, shoring and bracing to meet design and code requirements, so that resultant concrete conforms to required shapes, lines, and dimensions; and that formwork is able to support vertical and lateral loads until such loads can be supported by concrete structure.

H. Pre-Concrete Conference:
   1. This Pre-Concrete Conference is mandatory and no concrete work on building structure may commence until all conference criteria have been met to the satisfaction of the Design Team.
   2. At least 35 days prior to the start of the concrete construction schedule, the contractor shall conduct a meeting to review the proposed mix designs and to discuss the required methods and procedures to achieve the required concrete construction. The contractor shall send a pre-concrete conference agenda to all attendees 20 days prior to the scheduled date of the conference. The following shall be in attendance:
      a. Concrete supplier.
      b. Concrete Sub Contractor.
      c. Independent Testing Laboratory.
      d. Admixture supplier.
      e. Architect.
      f. Construction Manager.
   3. Minutes of the meeting shall be recorded, typed and printed by the contractor and distributed by the contractor to all parties concerned within 5 days of the meeting. One copy of the minutes shall also be transmitted to the following for information purposes: Owner's representative, Consultant engineer.
   4. The minutes shall include a statement by the concrete contractor indicating that the proposed mix design, and placing, finishing and curing procedures can produce the concrete quality required by these specifications.

5. A minimum of a 4 cubic yard trial mixture containing all required admixtures shall be placed at the job site using the accepted methods of placing, finishing and curing. This shall occur at least one week before actual concreting operations with the particular admixtures begin.
6. Architectural Concrete: Using same personnel, materials, equipment and construction techniques as will be used for final work, construct mock-up at least 8 feet wide and full height of the member, showing each surface treatment and joint construction methods proposed for use in the project. Mock-up drawings shall be submitted and approved prior to construction of mock up. Self-consolidating concrete shall be used and the proposed mix design shall be verified by a successful test placement onsite verifying proper workability, pumpability, setting time, and finish.
7. The Architect and Structural Engineer of Record shall have the option to be present at the conference.
8. The Contractor shall notify the Design Team at least 10 working days prior to the scheduled date of the conference.

I. Penetrating Hardener/Densifier Installer Qualifications:
1. Minimum of 15 concrete finish applications within last 3 years similar in type and size to Work of this Contract.
2. Assign experienced mechanics from previous applications including lead mechanic.
3. Provide letter of certification from the penetrating hardener/densifier manufacturer stating that installer is a certified applicator of the specified concrete finish material and is familiar with proper procedures and installation requirements required by manufacturer.

J. Concrete Floor Finish Applicator: Company specializing in concrete floor surface finishing with three years experience.

K. Concrete Floor Finishing: Furnish finishing materials in manufacturer's packaging with application instructions.
1. Interior concrete slab-on-grade: A minimum of one (1) finisher or finishing supervisor shall be a certified ACI Flatwork Finisher/Technical and shall be present during all interior slab-on-grade placement operations.

L. Waterstops: Samples of material, splicing details, and manufacturer’s literature indicating conformance with these Specifications for each type indicated.

M. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
1. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials.”
2. ACI 301, "Specification for Structural Concrete,"
3. ACI 302 “Guide for Concrete Floor and Slab Construction”.
4. ACI 304 “Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete”.
5. ACI 308 “Standard practice for Curing Concrete”.
6. ACI 309 “Standard Practice for Consolidation of Concrete”.
7. ACI 311 “Recommended Practice for Concrete Inspection”.
8. ACI 318, “Building Code Requirements for Structural Concrete.”

N. Conform to ACI 305 when concreting during hot weather.

O. Conform to ACI 306.1 when concreting during cold weather.

1.06 SUBMITTALS

A. Material and Equipment Submittals: Submit the following under provisions of Section 01 33 00:
1. Mix Design: Indicate proposed mix design of each class of concrete to Architect/Engineer review 21 days prior to commencement of work. Do not begin concrete production until mixes have been reviewed and accepted by Architect/Engineer.
a. Include mix design types indicating location and placement of each mix class.
b. Submit proportions of ingredients for each mix class.
c. Submit aggregate gradation analysis showing compliance with ASTM C33.

d. Submit cement and supplemental cementitious material brand and type, slump, water/cement ratio, and strength test reports for 7 and 28 day strengths.
    1) Submit product certifications for cement and/or blended hydraulic cements showing compliance with ASTM C150 and/or ASTM C595.
    2) Submit product certifications indicating compliance with ASTM C618 for fly ash and ASTM C989/C989M for Ground Granulated Blast Furnace Slag if used.
e. Submittal shall show aggregate compliance with applicable fire rating UL assembly as indicated on architectural drawings.
f. Submit signed certifications stating compliance with ACI 318 requirements for each mix design.
g. The proposed mix designs shall be accompanied by complete standard deviation analysis or trial mixture test data indicating compliance with ACI 301. Submitted data shall be within the last 24-month period.

2. The proposed mix designs shall be accompanied by complete standard deviation analysis or trial mixture test data indicating compliance with ACI 301.
3. Certification of compliance for each material furnished stating that material conforms to acceptable ASTM standards.
4. Proprietary materials and items including forming accessories, admixtures, patching compounds, joint systems, curing compounds, and dry-shake finish materials. Indicate product conformation to applicable specifications. Submit manufacturer's literature.
5. If Contractor proposes to use curing compound(s) in lieu of the preferred specified wet cure process, then Contractor shall submit concrete curing compound product data sheets (for approval) and a concrete finishing schedule (for information only) including the following:
    a. Curing compound manufacturer certifications that their proposed products are approved for use with the applicable project waterproofing manufacturers (for information only).
    b. Curing compound manufacturer certifications that their proposed products are approved for use with the applicable project floor finishes (for information only).
    c. Floor finish manufacturer approvals of the curing compounds proposed for use under their floor finish (for information only).
    d. Show on floor plan where curing compounds are proposed for use, and what floor finishes are to be applied at those locations (for information only).
    e. If Contractor chooses to use curing compounds that are not compatible with the associated floor finishes, submit proposed methods of removal of curing compounds and approval(s) by associated floor finish manufacturer(s) (for information only).
    f. Manufacturer coverage requirements (square feet per gallon) for each application (horizontal, vertical) and final finish type (troweled, broom, float, rough).
6. Contractor shall submit slab on grade and slab on insulation control and construction joint layout plan, as applicable, for review three weeks minimum prior to slab pour.
    a. The plan shall be coordinated by the Contractor with the architectural floor plan, structural floor plan and related structural details to locate joints beneath walls and fixtures, when possible.
7. Contractor shall submit composite slab construction joint layout plan for review three weeks minimum prior to slab pour.
    a. See structural drawings for guidelines on suggested construction joint locations.
8. Submit waterstop product information with corresponding joint locations identified.

B. Procurement:
1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
2. Submit inventory to Owner within 5 days of delivery of materials.
3. See Sections 01 33 00 and 01 60 00.

C. Quality Control Submittals: Submit the following under provisions of Section 01 40 00:
1. Concrete Delivery Tickets: Indicate quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump and time of batching for each load delivered.

2. Test Reports: Indicate project identification name and number, concrete placement date, testing service name, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials; compressive breaking strength and type of break for both 7-day tests and 28-day tests.

D. Perform and submit reports of Code Required Special Inspections as required in Section 01 45 33.

PART 2 PRODUCTS

2.01 GENERAL

A. Comply with recommendations of ADAAG for slip resistance using ASTM D2047 as follows:
   1. Accessible Routes (as defined by ADAAG): 0.6 static coefficient of friction.
   2. Ramps (as defined by ADAAG): 0.8 static coefficient of friction.

2.02 FORM MATERIALS

A. Conform to ACI 301.

B. Void Forms: Moisture resistant treated paper faces; biodegradable; structurally sufficient to support weight of wet concrete until initial set; Thickness to exceed expected potential movement of soil and/or concrete.
   1. Acceptable suppliers
      a. SureVoid by VoidForm
      b. Approved substitution

C. Compressible Material: Closed-cell Polyethylene Foam meeting the requirements of ASTM D3575-20 Standard Test Methods for Flexible Cellular Materials Made from Olefin Polymers
   1. Maximum compressive strength of 7 psi at 25% deformation
   2. Acceptable suppliers
      a. Ethafoam
      b. Approved substitution

2.03 FORMWORK ACCESSORIES

A. Form Ties: Removable or snap-off metal of adjustable length; 1-1/2" break back dimension; free of defects that will leave holes no larger than 1" diameter in concrete surface.

B. Form Release Agent: Proprietary mix, colorless material which will not stain concrete, absorb moisture, or impair natural bonding or color characteristics of coating intended for use on concrete.
   1. Products;
      a. FormShield Pure or Formshield WB by The Euclid Chemical Co
      b. Or approved substitution.

C. Fillets for Chamfered Corners: 3/4" x 3/4", wood, rigid plastic, metal or rubber type; maximum possible lengths; fabricated to produce uniform smooth lines and tight edge joints.

D. Nails, Spikes, Lag Bolts, Through Bolts and Anchorages: Sized as required; of strength and character to maintain formwork in place while placing concrete.

E. Below Grade Pipe Sleeves: ASTM A53, schedule 40, galvanized.

2.04 CONCRETE MATERIALS

A. Portland cement:
   1. ASTM C150, Type I or II & Type V as indicated ASTM C 1157, Type GU or LH Single brand and type of cement.
   2. High early strength option for footings and site cast concrete wall panels:
      a. ASTM C150, Type III High Early Strength, ASTM C1157, Type HE. Type III Portland cement may be used to produce high early strength concrete.
      b. Adding additional amounts of Type I Portland cement to produce high early strength concrete will not be permitted.
   3. ASTM C595. Type IL Blended Hydraulic Cement (Type IS and IT are excluded).

B. Supplementary Cementitious Materials:

1. Fly Ash ASTM C618, Type C or F
2. Ground Granulated Blast-Furnace Slag: ASTM C989, Grade 100 or 120
3. The exact percentages of supplementary cementitious materials used shall be based on a successful test placement on-site.

C. Fine and Coarse Aggregates: ASTM C33, Class 3S.
1. Provide aggregates from a single source for exposed aggregates.
2. Local aggregates not complying with ASTM C33, but which have shown by special test or actual service to produce concrete of adequate strength and durability may be used when acceptable to Architect.
3. Lightweight Concrete: Expanded Shale, Clay, or Slate (ESCS) lightweight aggregate produced by the rotary kiln method shall meet ASTM C330/C330M. Obtain from source with uniform density.
4. Minimum total coarse aggregate content of 12 cubic feet for 1 ½" or larger top size aggregate; 11.5 cubic feet for top size aggregate 1 ¼" or larger but less than 1 ½"; 11 cubic feet for topsize aggregate 1" or larger but less than 1 ¼"; or 10.5 cubic feet for topsize aggregate less than 1".

D. Water: Potable.

2.05 CONCRETE MIXING

A. Ready-Mix Concrete: Comply with requirements of ASTM C94, and as herein specified.

B. Provide batch ticket for each batch discharged and used in work, indicating project identification name and number, date, mix type, mix time, quantity, and amount of water introduced.

C. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C94 may be required. When air temperature is between 85 deg F (30 deg C) and 90 deg F (32 deg C), reduce maximum mixing and delivery time from 1-1/2 hours to 75 minutes, and when air temperature is above 90 deg F (32 deg C), reduce maximum mixing and delivery time to 60 minutes.

D. No water shall be added after mixing to concrete containing HRWR (Superplasticizer). If loss of slump occurs, HRWR may be redosed at the site as long as a "flash set" has not occurred. Redosage procedures must be discussed and approved by the Engineer and the manufacturer at the Pre-Concrete Conference.

E. No water is to be added on-site unless:
1. Total water does not exceed maximum w/cm specified
2. Water is added at direction of ready-mix supplier
3. Water addition is documented on delivery ticket.

2.06 PROPORTIONING AND DESIGN OF MIXES

A. Preparation of Design Mixes:
1. All mix designs shall be proportioned in accordance with Section 5.3, "Proportioning on the Basis of Field Experience and/or Trial Mixtures" of ACI 318. Submit mix designs on each class of concrete for review.
2. If field experience based mixes are submitted, all materials shall be from the same sources and with the same brand names as the previously utilized mix.
3. If trial batches are used, the mix design shall be prepared by an independent testing laboratory and shall achieve an average compressive strength 1200 psi higher than the specified strength. This over-design shall be increased to 1400 psi when concrete strengths of 5000 or more are used.
4. The proposed mix designs shall be accompanied by complete standard deviation analysis or trial mixture test data.
5. The testing facility shall not be the same as used for field quality control testing.
6. Supplemental Cementitious Materials
   a. Limit use of fly ash to not exceed 25 percent of cementitious content by weight.
   b. Limit use of slag to not exceed 40 percent of cementitious content by weight.

c. Combined fly ash and slag shall not exceed 50 percent by weight with fly ash not exceeding 25 percent by weight.
d. In mass concrete, more than 3 feet thick, the usage rate may be 50% for fly ash and 80% for slag.
e. The exact percentages used shall be based on a successful test placement on-site.

7. Proportion concrete mix designs appropriately to reach the required design strength and other properties noted and to be appropriate for their intended use. Use concrete admixtures in accordance with ASTM C494. Use air-entraining admixtures in accordance with ASTM C260

B. Concrete Mixes:
1. Design mixes to provide normal weight concrete with the following properties, as indicated on drawings and schedules below:

C. **Class A**: Interior Slab-on-Grade: Proportion normal-weight concrete mixture as follows:
1. Design Compressive Strength: 3000 psi minimum at 28 days.
2. Exposure Class in accordance with ACI 318: F0, S0, W1, C1
3. Cement Type: ASTM C150 Type I, Type II, or ASTM C595 TYPE IL
4. Concrete Density: Normal weight 150 pcf max
5. Maximum Water-Cementitious Materials Ratio: 0.50
6. Macro Fiber at a minimum dosage of 3.0 pounds per cubic yard (see related section below).
7. Maximum Aggregate Size: 1 1/2".

D. **Class B**: Exterior Slabs and Stoops: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: 4500 psi at 28 days.
2. Exposure Class in accordance with ACI 318: F2, S0, W1, C1
3. Cement Type: ASTM C150 Type I, Type II, or ASTM C595 TYPE IL
4. Concrete Density: Normal weight 150 pcf max
5. Maximum Water-Cementitious Materials Ratio: 0.45
6. Air Content: 6% +/- 1.5%.
7. Maximum Aggregate Size: 1 ½"

E. **Class C**: Footings, Piers, Foundation Walls, Elevator pits: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength:
a. 4000 psi at 28 days for F0 exposure
b. 4500 psi at 28 days for F2 exposure
2. Exposure Class in accordance with ACI 318: S0, W1, C1
a. F0 if element not exposed to freezing and/or is permanently buried in soil
b. F2 if element exposed to freezing and/or is not permanently buried in soil.
3. Cement Type: ASTM C150 Type I, Type II, Type III, or ASTM C595 TYPE IL
4. Concrete Density: Normal weight 150 pcf max
5. Maximum Water-Cementitious Materials Ratio: 0.45
6. Air Content:
a. None required at F0 exposure.
b. 6% +/- 1.5% at F2 exposure.
7. Maximum Aggregate Size: 1 ½".

F. **Class D**: Composite Floor Slabs on Deck, Isolation Slabs: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: 4000 psi at 28 days.
2. Exposure Class in accordance with ACI 318: F0, S0, W0, C0
3. Cement Type: ASTM C150 Type I, Type II, or ASTM C595 TYPE IL
4. Concrete Density: Normal weight 150 pcf max
5. Maximum Water-Cementitious Materials Ratio: 0.50
6. Macro Fiber at a minimum dosage of 4.0 pounds per cubic yard (see related section below)
7. Slump Limit: 3-5 inches
8. Air Content: None required.

9. Maximum Aggregate Size: ¾”.
10. Aggregate type shall comply with applicable fire rating UL assembly as indicated on Architectural drawings.

G. **Class E**: Water retaining vessels, Backwash pits, Surge tanks and Collector tanks: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: 5000 psi at 28 days.
2. Exposure Class in accordance with ACI 318: F2, S0, W2, C1
3. Cement Type: ASTM C150 Type I, Type II, or ASTM C595 TYPE IL
4. Concrete Density: Normal weight 150 pcf max
5. Maximum Water-Cementitious Materials Ratio: 0.40
6. Air Content: None required.
7. Maximum Aggregate Size: ¾”.

H. **Class F**: PT Tennis/Pickleball Court Slabs: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: 5000 psi at 28 days.
2. High-Early Compressive Strength: 3000 psi at 24 hours.
3. Exposure Class in accordance with ACI 318: F2, S0, W2, C1
4. Cement Type: ASTM C150 Type I, Type II, or ASTM C595 TYPE IL
5. Concrete Density: Normal weight 150 pcf max.
6. Surface Profile: Coordinate with Surfacing manufacturer. (CSP 3 typ)
7. Maximum Water-Cementitious Materials Ratio: 0.45
8. Air Content:
   a. Exterior: 6% +/- 1.5%
   b. Interior: None required.
9. Maximum aggregate size: 1 ½”.

I. **Class J**: Interior Concrete 2" or less in thickness including Stair Pans: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: 3000 psi at 28 days.
2. Exposure Class in accordance with ACI 318: F0, S0, W0, C0
3. Cement Type: ASTM C150 Type I, Type II, or ASTM C595 TYPE IL
4. Concrete Density: Normal weight 150 pcf max.
5. Maximum Water-Cementitious Materials Ratio: 0.50
6. Slump Limit: 3-5 inches.
7. Air Content: None required.
8. Maximum Aggregate Size: 3/8”.

J. Macro Fiber for Class A: Slab-on-grade and Class D: Interior Composite Slabs, Topping Slabs:
1. Concrete slabs where indicated shall contain specified Structural Synthetic Macro Fiber at a dosage rate as indicated on drawings. Fibers may be added at plant location or job-site and shall be mixed in concrete for a minimum of 4 minutes.

K. Synthetic Macro-Fiber: Polyolefin macro-fibers engineered and designed for use in concrete, complying with ASTM C1116/C1116M, Type III, minimum 1-1/2 inches (51 mm) long, average minimum equivalent residual strength (f_{e3}) of 150 psi when tested at a dosage rate of 4.0 pounds per cubic yard in accordance with ASTM C1609..
1. Synthetic macrofiber shall be tested in concrete to meet the requirements of ICC-AC383.
2. Fiber must provide minimum plastic shrinkage crack reduction of 86 percent when tested in accordance with ASTM C1579.
3. Synthetic macrofiber in fire rated assemblies to be UL-certified for 2-hour minimum fire-resistance-rated construction when used in lieu of welded wire fabric in UL Design Series D700, D800, and D900 Floor-Ceiling Assemblies.
4. Products: Subject to compliance with requirements, provide one of the following:
   a. Euclid Chemical Company (The), an RPM company: Tuf-Strand SF.
   b. FORTA Corporation: FORTA FERRO.
   c. Grace Construction Products, W. R. Grace & Co.: Strux 90/40.

d. Nycon, Inc.: XL.
e. Sika Corporation: SikaFiber Force-650, Fibermesh-650.
f. BASF: MasterFiber MAC100

L. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant; at no additional cost to Owner and as accepted by Architect. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Architect before using in work.

2.07 ADMIXTURES

A. Admixtures:
1. Use water-reducing admixture or high range water-reducing admixture (Superplasticizer) in all concrete as required for placement and workability.
2. Accelerating: Use the specified non-corrosive, non-chloride containing accelerator in all concrete, less than 8 inches in thickness, placed at air temperature below 50 degrees F.
3. Use high-range water-reducing admixture in pumped concrete, architectural concrete, concrete required to be watertight, self-consolidating concrete, concrete with ultimate strength of 5,000 psi or more, and concrete with water/cement ratios below 0.50.
4. All concrete exposed to freezing and thawing and/or required to be watertight shall have an air content of 4.5% to 7.5%.
5. Integral finishing admixture may be used to reduce concrete bleeding, segregation and rapid moisture loss from surface. Do not use in concrete to receive dry shake hardeners.
6. Use shrinkage-reducing and/or shrinkage-compensating admixtures in concrete mixtures as required to achieve maximum allowable shrinkage when specified.
7. Use permeability-reducing admixture in concrete mixtures where indicated.

B. Shrinkage Compensating Admixture:
1. Conex by The Euclid Chemical Company.

C. Prohibited Admixtures: Calcium chloride thiocyanates or admixtures containing more than 0.05 percent chloride ions are not permitted.

D. Air Entraining Admixture: Comply with ASTM C260, and be certified by the manufacturer to be compatible with other admixtures to be used.
1. Acceptable Manufacturers/Products:
a. Euclid Chemical Company – Air Mix, Air Max or AEA Series.
b. Chryso - Darex or Daravair series.
c. Master Builders - MB-VR or MB-AE

E. Water-Reducing Admixture: Conform to ASTM C494, Type A, and compatible with other admixtures in the same mix design.
1. Acceptable Manufacturers/Products:
a. Euclid Chemical Company, Eucon MR Series, Eucon X Series or Plastol Series.
b. BASF, Pozzolith Series.
c. WR Grace, WRDA Hycol.

F. Water-Reducing, Retarding Admixture: Conform to ASTM C494, Type D and not more than 0.05 percent chloride ions.
1. Acceptable Manufacturers/Products:
a. Euclid Chemical Company, Eucon Retarder-75 or Eucon DS.
b. BASF, Pozzolith 100XR.
c. Sika Corporation, Plastocrete 10N
d. WR Grace, DaratardSeries.
2. Compatible with other admixtures in the same mix design.

G. High-Range Water-Reducing Admixture: Conform to ASM C494, Type F or Type G and containing not more than 0.05 percent chloride ions.
1. Acceptable Manufacturers/Products:
a. Euclid Chemical Company, Eucon 37, 537 or Plastol Series

b. BASF, Rheobuild 1000 or Glenium Series.
c. WR Grace, Daracem or Adva series.

2. Compatible with other admixtures in the same mix design.

H. Non-Corrosive, Non-Chloride Accelerator: The admixture shall conform to ASTM C494, Type C or E, and not contain more chloride ions than are present in municipal drinking water. The admixture manufacturer must have long-term non-corrosive test data from an independent testing laboratory (of at least a year's duration) using an acceptable accelerated corrosion test method such as that using electrical potential measures.

1. Acceptable Manufacturers/Products:
   a. Euclid Chemical Company, Accelguard 80/90 or NCA.
   b. Conform to ASTM C494, Type C or E.
2. Compatible with other admixtures in the same mix design.

I. Crystalline Waterproofing Admixture: Integral crystalline admixture specifically formulated to interact with capillary pore structures to provide a waterproofing system that is a permanent part of the concrete matrix. Admixture shall provide the following properties:

1. Water Penetration per DIN 1048 — 40% Reduction at 72 psi.
2. Water Permeability per CRD C48-92 — >70% Reduction at 200 psi
3. Capillary Absorption per ASTM C-1585 — >40% Reduction
4. Compressive Strength per ASTM C-39 — Equal to and up to 8% increase
5. Resistance to Chloride Penetration per ASTM C-1202 — 10% improvement
6. Basis of Design Product:
   a. Euclid Chemical Company (The); Vandex AM-10 or Vandex AM10L,

2.08 CURING MATERIALS

A. Water: Clean and not detrimental to concrete or steel. Potable or complying with ASTM C1602/C1602M.

B. Evaporation Retarder:

1. Manufacturers/Products: Subject to compliance with requirements, provide by one of the following:
   a. "Eucobar", Euclid Chemical Co.
   b. "MasterKure ER 50", BASF

C. Moisture Cover Type:

1. Absorbent Covers: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry. These materials must be free of harmful substances, such as sugar or fertilizer, or substances that may discolor the concrete. To remove soluble substances, burlap should be thoroughly rinsed in water before placing it on the concrete.
2. Moisture Retaining Covers:
   a. Plastic Film: ASTM C171, 10 mil minimum thickness polyethylene film
   b. White burlap-polyethylene sheet meeting ASTM C171
   c. Reinforced Curing Paper: Complying with ASTM C171
   d. Moisture Retaining Fabric: Conforming to ASTM C171: A naturally colored, non-woven polypropylene fabric with a 4-mil non-perforated reflective (white) polyethylene coating containing stabilizers to resist degradation from ultraviolet light. Fabric shall exhibit low permeability and high moisture retention.
   e. Acceptable Manufactures/Products;
      1) PNA Construction Technologies, Inc.; HydracureS16.
      2) Reef Industries Incorporated; Transguard 4000.

D. Curing Compounds:

1. See submittals sections for additional submittal requirements if the Contractor proposes the use of curing compounds.
2. Clear, Waterborne, Membrane-Forming, Dissipating Curing Compound: ASTM C309, Type 1, Class B.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1) Anti-Hydro International, Inc.; AH Curing Compound #2 DR WB
   2) ChemMasters, Inc.; Safe-Cure Clear
   3) Dayton Superior Corporation; Clear Resin Cure J11W
   4) Euclid Chemical Company (The); an RPM company; Kurez DR VOX or Kurez DR 100
   5) Kaufman Products, Inc.; Thinfilm 420
   6) Lambert Corporation; Aqua Kure-Clear
   7) Nox-Crete Products Group; Res-Cure DH 100
   8) Vexcon Chemicals Inc.; Certi-Vex Envio Cure 100
   9) W.R. Meadows, Inc.; 1150 Clear
   10) L&M: L&M Cure R
   11) SpecChem: SpecRez

2.09 SEALANTS

A. Sealant and Primer: Specified in Section 07 92 00.

2.10 FINISHING MATERIALS

A. Liquid Sealer Densifier: The liquid densifier compound shall be a siliconate based sealer which penetrates concrete surfaces, and provides a "low-sheen" surface that is easy to clean and eases the problem of tire mark removal. The compound must contain a minimum solids content of 20% of which 50% is siliconate.
   1. Manufacturers/Products: Subject to compliance with requirements, provide one of the following:
      a. "Euco Diamond Hard", The Euclid Chemical Co.
      b. Or approved substitution.

2.11 INTEGRAL JOINT MATERIALS

A. Formed Construction Joints: Tongue groove type profile; knockout holes at 6" o.c. to receive doweling; with anchors.

B. Control Joint Insert: T-shaped plastic strip, 1/16" thick with 3/4" wide removable top and barbed bottom. Depth not less than 1/4 slab thickness. Similar to Greenstreak Plastic Products, "Zipcap Control Joint Former".

C. Joint Filler (bond breaker): ASTM D1751, 1/2" thick, pre-formed, resilient, non-extruding, asphalt impregnated, vegetable fiber and finely divided mineral filler.

D. Column Isolation Joint Filler: Plastic circular type, designed to lock shut around columns, full slab thickness.

E. Waterstops:
   1. PVC waterstop.
      a. Provide flexible 100 percent virgin specification grade Polyvinyl Chloride (PVC) Waterstop, Sika Greenstreak, or equal.
      b. Resistance to hydrostatic head – 65 feet of water (moving or non-moving joints).
      c. Profile: Provide profile of type suitable for application and as follows.
         1) Moving joints, expansion, or contraction joints:
            (a) Rib with center bulb.
            (b) Provide in widths indicated in Drawings.
         2) The PVC waterstop shall be extruded from an elastomeric plastic material, of which the basic resin is prime, virgin polyvinyl chloride. The PVC compound shall not contain any scrapped or reclaimed material or pigments.
      d. Accessories.
         1) Provide factory fabricated waterstop connections for all changes of direction, intersections, and transitions leaving only butt joint splicing for the field.
         2) Provide hog rings, grommets or holes spaced at 12 inches on center along the length of the waterstop.

3) Provide thermostatically controlled, Teflon covered waterstop splicing irons for field splicing.

2. Strip waterstop.
   a. Resistance to hydrostatic head – 65 feet of water (non-moving joints).
   b. Henry SF302 Synko-Flex waterstop as manufactured by Henry Company, or equal.
      1) Non-swelling preformed joint sealant.
      2) Applicable for both fresh and cured concrete surfaces.
      3) Single component.
      4) Self-sealing adhesive compound.

2.12 ACCESSORIES

A. Vapor Barrier: Provide vapor barrier which conforms to ASTM E1745, Class A. The membrane shall have a water-vapor transmission rate no greater than 0.008 gr./ft2/hr when tested in accordance with ASTM E96. The vapor barrier shall be placed over prepared base material where indicated below slabs on grade. Vapor barrier shall be no less than 15 mil thick. Use only materials which are resistant to decay when tested in accordance with ASTM E154.
   1. Products Subject to compliance with requirements, provide one of the following:
      a. "Stego Wrap (15 mil) Vapor Barrier": Stego Industries LLC
      b. "Pre-moulded Membrane with PLASMATIC CORE", W.R. Meadows.
      c. "Griffolyn Vaporguard" Reef Industries

B. Non-shrink Grout: Conforming to ASTM C1107 "Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-Shrink). Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 8,000 psi in 28 days;
   1. Manufacturers/Products: Subject to compliance with requirements, provide one of the following:
      a. "Masterflow 713", Sika
      b. "Euco-NS', Euclid Chemical Co;
      c. "Five Star Grout," U.S. Grout Co;

C. Underlayment Compound: Free flowing, self-leveling, pumpable cementitious base compound.
   1. Manufacturers/Products: Subject to compliance with requirements, provide the following:
      a. "EucoFloor SL160", The Euclid Chemical Co
      b. "Ardex K-40", Ardex Co.

D. Bonding Compound: Polyvinyl acetate, re-wettable type;
   1. Manufacturers/Products: Subject to compliance with requirements, provide the following:
      a. "Eucoweld 2.0", Euclid Chemical Co;
      b. "Daraweld C", Chryso;
      c. "Master Emaco", Sika

E. Epoxy Adhesive: ASTM C881, two (2) components, 100% solids, 100% reactive compound suitable for use on dry or damp surfaces.
   1. Manufacturers/Products: Subject to compliance with requirements, provide one of the following products, or acceptable product by listed Manufacturer:
      a. "Sikadur Hi-Mod", Sika Corp.
      b. "Dural 452":, The Euclid Chemical Co.

F. High Strength Flowing Topping and Repair Mortar: For forming and pouring structural member repairs, or large horizontal repairs, provide the flowable one-part, high strength microsilica modified repair mortar with 3/8" aggregate. The product shall achieve 9,000 psi at 28-days at a 9-inch slump.
   1. Manufacturers/Products: Subject to compliance with requirements, provide one of the following:
      a. "Eucocrete": Euclid Chemical Co.

G. Polymer Patching Mortar: Polymer and microsilica modified cementitious based compounds.
   1. Manufacturers/Products: Subject to compliance with requirements, provide one of the following:
      a. Horizontal:
         1) "Thin Top Supreme": Euclid Chemical Co.

2) "Concrete Top Supreme", Euclid Chemical Co.
3) "VersaSpeed LS100", Euclid Chemical Co.
4) "Tammspatch II": Euclid Chemical Co.
5) "Emaco R300 CI": Sika
6) "Emaco R310 CI": Sika

b. Vertical/Overhead:
1) "EucoRepair V100", Euclid Chemical Co.
2) "Emaco N420 CI": Sika

H. Anchors in concrete: See Specification Section 05 12 00 and Structural Drawings for information.

I. Cast-In – Place Detectable/Tactile Warning Surfaces:
1. Products: Subject to compliance with requirements, provide one of the following:
a. "The Vitrified Polymer Composite (VPC) Cast In Place Detectable/Tactile Warning Surface Tile specified is based on Armor-Tile manufactured by Engineered Plastics Inc. (800-682-2525). Existing engineered and field tested products, which have been in successful service for a period of three (3) years are subject to compliance with requirements, may be incorporated in the work and shall meet or exceed the specified test criteria and characteristics.
b. Color: Yellow conforming to Federal Color No. 33538. Color shall be homogeneous throughout the tile. Tiles are also available in Light Grey (Federal Color No. 26280), Dark Grey (Federal Color No. 36118), Onyx Black (Federal Color No. 17038), Pearl White (Federal Color No. 37875), Brick Red (Federal Color No. 22144).

PART 3 EXECUTION

3.01 COORDINATION

A. Ensure all work required to be in place, and furnished by other sections, is coordinated and correctly placed prior to concrete placement.

3.02 SCHEDULES

A. Formwork Schedule:
1. Location: Form Finish Material
2. Exposed: Smooth plywood, steel, gfr plastic.
3. Unexposed Semi-smooth Lumber, plywood, steel, gfr plastic.

B. Curing Schedule:
1. Moisture Retaining: Slabs on grade and structural slabs.
2. Water Cure, Absorptive Mat, or Moisture Retaining: Other areas
3. If Curing Compound used: All areas per manufacturer recommendations and following

C. Floor Slab Finish Schedule:
1. Trowel: Exposed to view, thin-set tilework.
2. Broom or Belt: Exterior platforms, sidewalks, steps, and ramps.
3. Float: Full-bed-set tilework.
4. Penetrating Sealer Hardener: Exposed interior, unfinished floor areas.
5. Non-Slip

3.03 FORMWORK INSTALLATION

A. Formwork Inspection:
1. Verify lines, elevations and measurements before proceeding with formwork.

B. Formwork Preparation:
1. Earth forms not permitted, unless written approval given by Architect.
2. Minimize form joints. Symmetrically align joints and make water tight to prevent leakage of mortar.
3. Arrange and assemble formwork to permit stripping, so that concrete is not damaged during its removal.

4. Arrange forms to allow stripping without removal of principal shores, where required to remain in place.

C. Formwork Erection:
   1. Construct formwork and camber beams and slabs to maintain tolerances in accordance with ACI 301.
   2. Provide bracing to ensure stability of formwork. Strengthen formwork liable to be over stressed by construction loads.
   3. Provide temporary ports in formwork to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain. Close ports with tight fitting panels, flush with inside face of forms, neatly fitted so that joints will not be apparent in exposed concrete surfaces.
   4. Provide chamfer strips on all exposed external corners.
   5. Build-in sleeves, anchors, inserts, bolts and other devices indicated or required. Provide sleeves 1/2" larger in diameter than piping to be sleeved, unless otherwise indicated. Install sleeves flush with finished surfaces. Coordinate and build in sleeves, thimbles, and other items furnished or set in place by other sections.
   6. Do not displace or damage vapor barrier.

D. Preparation of Form Surfaces:
   1. Apply form release agent on formwork in accordance with manufacturer's instructions. Apply prior to placing reinforcing steel, anchoring devices, and embedded items.
   2. Coat steel forms with a non-staining, rust-preventative form oil or otherwise protect against rusting. Rust stained steel formwork is not acceptable.
   3. Do not apply form release agent where concrete surfaces are scheduled to receive rough wood texture or special finishes which may be affected by agent. Soak contact surfaces of untreated forms with clean water. Keep surfaces wet prior to placing concrete.

E. Formwork Inserts, Embedded Parts, and Openings:
   1. Provide formed openings where required for work embedded in or passing through concrete.
   2. Coordinate work of other Sections in forming and setting openings, slots, recesses, chases, sleeves, bolts, anchors, and other inserts.
   3. Install accessories in accordance with manufacturer's instructions, level and plumb. Ensure items are not disturbed during concrete placement.
   4. Verify lines, elevations and measurement before proceeding with formwork.

F. Formwork Cleaning:
   1. Clean forms to remove foreign matter as erection proceeds.
   2. Ensure that water and debris drain to exterior through clean-out ports.
   3. During cold weather, remove ice and snow from forms. Do not use de-icing salts, calcium chloride or other materials containing antifreeze agents or chemical accelerators, unless otherwise accepted in mix designs. Do not use water to clean out completed forms, unless formwork and construction proceed within heated enclosure. Use compressed air to remove foreign matter.

G. Form Removal:
   1. Do not remove forms, shoring and bracing until concrete has sufficient strength to support its own weight, and construction and design loads which may be imposed upon it.
   2. Remove formwork progressively so no unbalanced loads are imposed on structure.
   3. Do not damage concrete surfaces during form removal.
   4. Store reusable forms for exposed architectural concrete to prevent damage to contact surfaces.
   5. Exposed Concrete Surfaces:
      a. Remove formwork in same sequence as concrete placement to achieve similar concrete surface coloration.
      b. Clean surfaces of forms to be reused in Work.
      c. Split, frayed, delaminated, patched or damaged form facing material will not be acceptable for exposed surfaces.
      d. Apply new form coating compound as specified for new formwork.

3.04 VAPOR BARRIER INSTALLATION

A. Install vapor barrier above the sand base under interior slabs on grade. Lap joints minimum 6” and tape. Do not disturb or damage vapor barrier while placing concrete. Repair damaged vapor barrier. Vapor barrier installation must comply with the requirements of ASTM E1643-98.

3.05 CONCRETE MIXES

A. Submit proposed mix design of each class of concrete to testing laboratory for review prior to commencement of Work.

B. Mix concrete in accordance with ASTM C94 (Option C).

C. High Early Strength: Type III Portland cement may be used to produce high early strength concrete. Adding additional amounts of Type I Portland cement to produce high early strength concrete will not be permitted

3.06 CONCRETE PLACEMENT

A. Inspection:
   1. Verify formwork, anchors, seats, plates, reinforcement, and other items to be cast into concrete are accurately placed, held securely, and will not cause hardship in placing concrete.
   2. Verify all required inspections have been performed.
   3. The use of the LTF Construction POUR CARD is a requirement before pouring, and before payment is to be issued. This subcontractor must get this approval before pouring, without approval this subcontractor will bear all responsibility (of his work) for repair, demolition, delays and etc. This is a protection device initiated to eliminate mistakes by all parties involved prior to concrete placement.

B. Preparation:
   1. Thoroughly clean forms before placing concrete. Dampen masonry and porous earth in contact with concrete. Do not place concrete on water or frozen ground.
   2. Prepare previously placed concrete by cleaning with steel brush and thoroughly wet and slush with neat cement grout immediately before placing new concrete.

C. Placing Concrete:
   1. Place concrete as close as possible to final position. Prevent segregation. Place with maximum free drop of 5 feet. Compact during placing with internal vibrators (8000 vpm minimum). Work around reinforcement, embedded items and into form corners. Do not use vibrators to transport concrete within forms. Vibrators shall be used for slab-on-grade placements with focus on slab edge consolidation. Use and type of vibrators shall conform to ACI 309 "Recommended Practice for Consolidation of Concrete".
   2. Place concrete within one hour after mix water has been added.
   3. Place concrete in accordance with ACI 301, and as follows:
   4. Cold Weather Placement:
      a. Conform with requirements of ACI 306R.
      b. Protect work from physical damage or reduced strength caused by frost, freezing, or low temperatures.
      c. If at 40 deg F or expected, uniformly heat aggregates and water before mixing, to obtain 50-80 deg F mixture temperature at point of placement.
      d. Do not use frozen materials or materials containing snow or ice, or place on frozen subgrade or subgrade containing frozen materials.
      e. Do not use calcium chloride, salt and other materials containing antifreeze agents or chemical accelerators, unless otherwise accepted in mix designs.
   5. Hot Weather Placement:
      a. Conform with requirements of ACI 305R.
      b. Cool ingredients to maintain 90 deg F concrete temperatures at time of placement.
      c. Mixing water may be chilled, or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing.

d. Cover reinforcing steel with water-soaked burlap, to ensure steel temperature will not exceed ambient air temperature immediately before embedment in concrete.
e. Wet forms thoroughly before placing concrete.
f. Use water-reducing retarding admixture (Type D) when required by high temperatures.

6. Ensure reinforcement, inserts, embedded parts and formed joints are not disturbed during concrete placement.
7. Excessive honeycomb or embedded debris in concrete is not acceptable. Notify Architect upon discovery.
8. Maintain concrete cover around reinforcing as noted in ACI 318, Chapter 20 and as shown in the drawings/details.
9. Placing Composite Topping: Remove all Laitance and saturate surface with water. Remove all standing water.

D. Additional Composite Deck Requirements
1. The contractor shall be cognizant of allowable construction live loads (including personnel and equipment) and plan concrete placing operations accordingly so as to not overstress or damage the deck. The contractor shall verify with the deck manufacturer that the proposed concrete placing operation is compatible with the type, gauge, span, and length of the composite deck as furnished,
2. When placing concrete on metal deck, use of a ride-on laser screed is prohibited. Floors to be screeded from beams to a constant thickness, not to level within a bay. Deck is designed to handle wet weight of concrete plus 150 lb concentrated load per flute in one span of deck or non-concurrent 20 psf construction live load.See ANSI/SDI-C-1.0 for more information.
3. Confirm presence of qualified on-site inspection and concrete placement observation immediately prior to and during concrete placement.

3.07 TOLERANCES / MONOLITHIC SLAB FINISHES

A. Determining Floor Flatness and Levelness Using the "F Number" System (Inch-Pound Units). All slabs shall achieve the specified overall tolerance. The minimum local tolerance (1/2 bay or as designated by the architect) shall be 2/3 of the specified tolerances. All elevated slabs shall achieve the specified FL tolerance after the removal of the forms.
1. FF defines the maximum floor curvature allowed over 24 in. Computed on the basis of successive 12 in. (300 mm) elevation differentials, FF is commonly referred to as the "Flatness F-Number".
2. FL defines the relative conformity of the floor surface to a horizontal plane as measured over a 10 ft. (3.05 m) distance commonly referred to as the "Levelness F-Number".
3. All floors shall be measured in accordance with ASTM E1155 "Standard Test Method for levelness.

B. Screed exposed concrete floors and floors to receive resilient flooring, carpet, or thin-set ceramic and quarry tile to an even, level plane. Float and provide troweled finish in accordance with procedures in ACI 301, Chapter 11 and as recommended by ACI to achieve floor flatness and levelness specified. Uniformly slope to elevations shown on the Drawings to floor drains. The final troweling operation shall be free of trowel marks, uniform in texture and appearance. Grind smooth, surface defects, which would telegraph through applied floor system. Finished surfaces, other than rooms with floor drains, shall have floor flatness and levelness as determined in accordance with ASTM E1155 as indicated in the tables below.

C. Corrective measures, acceptable to the Architect, may be made to floor slabs scheduled to receive finish materials.

D. Corrective measures such as grinding, planning, surface repair or retopping will not be permitted for floor slabs scheduled for clear sealer/hardener finish.

E. In areas with floor drains, maintain floor level at walls. Slope surface uniformly to drains allowing a 1/2" recess at drain from approximately 4' x 4' around drain.

SLAB-ON-GRADE TOLERANCES TABLE

Occupancy	F_F (Flatness)	F_L (Levelness)	Gap
Non-critical areas such as mechanical rooms and surfaces to have thick set tile.	20	15	5/16"
Carpeted areas:	25	20	1/4"
Thin-set flooring:	35	25	1/8"
Resilient Tile flooring:	36	20	3/16"
Large format tile (as identified by TCNA), Tennis and Pickleball Surfaces.	50	25	1/8"

SUPPORTED FLOOR TOLERANCES TABLE

Occupancy:	F_F (Flatness)	F_L (Levelness)	Gap
Non-critical areas such as mechanical rooms and surfaces to have thick set tile:	20	-	5/16"
Carpeted areas:	25	-	1/4"
Thin-set flooring:	35	-	1/8"
Resilient Tile flooring	36		3/16"
Wood floors:	35	-	1/8"
Large format tile (as identified by TCNA):	50	-	1/8"

3.08 JOINT INSTALLATION

A. Locate and form expansion control and contraction joints to pattern as shown on Drawings.

B. Place formed construction joints in floor slab pattern placement sequence. Set top screed to required elevations. Secure to resist movement of wet concrete.

C. Install joint fillers and sealants in accordance with manufacturer's instructions. Use primers of type recommended by joint filler and sealant manufacturer.

D. Place concrete continuously between predetermined construction and control joints. Do not break or interrupt successive pours such that cold joints occur.

E. Construction Joints:
   1. Joints not shown on Drawings to be located so as not to impair strength or appearance of structure, as determined by Architect/Engineer.
   2. Provide key ways at least 1-1/2" deep in wall, and wall to footing construction joints.
   3. Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints. Provide diamond dowels where directed.
   4. Roughen and thoroughly clean surface of concrete, remove laitance, and wet surface before placing new concrete against joint. Slush vertical joints with neat cement grout immediately before placing new concrete.
   5. Place construction joints in reinforced concrete only as indicated on reinforcing steel shop drawings.
   6. Contractor to submit composite slab construction joint layout plan for review and approval a minimum of three weeks prior to pour.

F. Control Joints:
   1. Locate control joints for interior slab-on-grade based on criteria shown on structural drawings.
      a. Contractor to submit control joint layout plan for review and approval a minimum of three weeks prior to pour.
   2. Slabs on Grade: Use joint inserts or saw cut.
      a. See plan for joint depth.

b. Cut using a 1/16 to 1/8 inch (max.) thick blade. Cut a minimum 1/3 Depth of Concrete (d/3). Chalk lines and concrete dust shall be removed completely and immediately after cutting operation
c. Early entry saw may be used immediately after concrete finishing when cutting action will not tear, ravel, abrade, or otherwise damage surface and before concrete develops random contraction cracks, to cut control joints to depth of D/3. Saw cutting shall proceed no more than 12-hours after concrete placement.
d. Place joint inserts in groove formed in concrete with metal straight edge.

3. Sidewalks: Score with finishing tool to 1/4 slab depth; 8 ft o.c. each way maximum, unless shown otherwise on Drawings.

G. Isolation Joints:
1. Provide isolation joints at interior slabs-retaining walls and columns, exterior slabs on fill to vertical surfaces.
2. Form joint with joint filler from bottom of slab to within 1/2" of finished slab surface.

H. Expansion Joints:
1. Locate where indicated on Drawings and where exterior slabs abut restraining walls. Do not run reinforcing through joints. Form joints with joint filler extending full depth of slab, unless otherwise indicated. Hold joint filler 3/8" below concrete surface.

3.09 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Special Structural Testing and Inspection Services: Perform Structural Testing and Inspection by qualified parties as specified herein and per Section 01 45 33. Include items required by the Currently adopted IBC Section 1705.3, the Drawings, and other items which in the professional judgment of the Structural Engineer of Record, are critical to the integrity of the building structure.

C. Provide free access to Work for appointed testing and inspecting agencies.

D. Maintain records of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken.

E. Cure cylinders in same proximity to and protected and cured in same manner as in-place concrete from which sample was taken.

F. On a periodic basis, inspect formwork for shape, location and dimensions of concrete members being formed. Verify in-situ concrete strength prior to removal of shores and forms from beams and slabs.
1. Contractor’s formwork design engineer to inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, applicable code requirements and that supports, fastenings, wedges, ties, embedded items and all other items are secure.
2. Schedule concrete placement to permit formwork inspection before placing concrete.

G. Notify Architect/Engineer with sufficient time to allow Architect/Engineer to schedule a site visit after placement of reinforcing steel in forms, but prior to placing concrete.

H. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of Work.

I. Concrete Inspections:
1. Continuous Placement Inspection: Inspect for proper installation procedures and the following:
a. Batch tickets conform to approved mix designs.
b. Total water added to mix on site does not exceed that allowed by the mix design.
c. Concrete quality is indicative of adequate mixing time, consistency and relevant time limits.
d. Acceptable general condition of concrete base prior to placement.
e. Concrete conveyance and depositing avoids segregation and contamination.
f. Concrete is properly consolidated.
g. Reinforcement remains in proper location during concrete placement.

2. For all embedments installed in concrete, verify specified size, type, spacing, configuration, embedment, quantity, concrete placement and consolidation.
    a. Post-installed anchors including conformance with manufacturer's installation procedures and the requirements of the ICC ESR report(s).
3. Periodic Curing Inspection: Inspect for specified curing temperature and procedures. Verify hot and/or cold weather procedures are followed.

J. Strength Test Samples:
1. Sampling Procedures: ASTM C172.
2. Cylinder Molding and Curing Procedures: ASTM C31/C31M, cylinder specimens, standard cured.
3. Sample concrete and make one set of five 4x8 or four 6x12 cylinders for each day's pour between one and 25 cubic yards. If a day's pour exceeds 25 cubic yards, make five 4x8 or four 6x12 cylinders for each additional 50 cubic yards.
4. When volume of concrete for any class of concrete would provide less than 5 sets of cylinders, take samples from five randomly selected batches, or from every batch when less than 5 batches are used.
5. Make one additional cylinder during cold weather concreting, and field cure.

K. Field Testing:
1. Slump Test Method: ASTM C143/C143M.
2. Air Content Test Method: ASTM C173/C173M or ASTM C231.
3. Temperature Test Method: ASTM C1064/C1064M.
4. Measure slump and temperature for each compressive strength concrete sample.
5. Measure air content in air entrained concrete for each compressive strength concrete sample.

L. Cylinder Compressive Strength Testing:
1. Test Method: ASTM C39/C39M.
2. Test Acceptance: In accordance with ACI 318.
3. Test one cylinder at 7 days.
4. Test three 4x8 or two 6x12 cylinders at 28 days.
5. Retain one cylinder for 56 days for testing when earlier tests show low strength.
6. Dispose remaining cylinders when testing is not required.

M. Core Compressive Strength Testing:
1. Sampling and Testing Procedures: ASTM C42/C42M.
2. Test Acceptance: In accordance with ACI 318.
3. Drill three cores for each failed strength test from concrete represented by failed strength test.

N. Maintain records of concrete placement. Record date, location, quantity, air temperature and test samples taken.

O. Reinforcement Inspection:
1. Placement Acceptance: Specified material requirements and specified placement tolerances.
2. Welding:
    a. Inspect reinforcement welds in accordance with AWS D1.1 and D1.4. and confirm weldability of reinforcing with ASTM A706.
    b. Embedded welded connections. Coordinate continuous and periodic inspections with requirements in Section 05 12 00.
3. Placement Inspection Prior to Each Pour:
    a. Inspect for correct materials, fabrication, sizes, locations, spacing, concrete cover splicing, lap lengths and coatings.
    b. Verify bars are free of dirt, oil, excessive rust and damage.
    c. Verify bars are adequately tied, chaired and supported to prevent displacement during concrete placement.

P. Test Results:
1. Submit test reports with information requested in Submittals portion of this Section.

2. Report in writing on same day tests made.
3. Non-Compliant Test Reports: All test reports indicating non-compliance should be e-mailed or faxed immediately to all parties on the test report distribution list. Copies shall be on different colored paper.

Q. Additional Tests:
1. Testing service shall make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by Structural Engineer or Architect.
2. Testing service may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42, or by other methods as directed.

3.10 CONCRETE PROTECTING AND CURING

A. Protect finished work under provisions of Section 01 60 00.

B. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

C. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during placement.

D. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

E. Cure concrete for a duration and with means and methods adequate to ensure that 100% of the specified value for concrete properties are developed at 28 days

F. Changes in temperature of concrete shall not exceed 5 deg F in any one hour or 50 deg F in any 24 hour period.

G. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.1 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions one or more times after placing, screeding, and bull floating or darbying concrete, but before float finishing.

H. Formed Surfaces: Cure formed concrete surfaces utilizing final curing methods per ACI 308.1, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure, after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period, as follows.
1. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
2. Continuous Sprinkling: Maintain concrete surface continuously wet.
3. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.
4. Water-Retention Sheeting Materials: Cover exposed concrete surfaces with sheeting material, taping, or lapping seams.
5. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
   a. Recoat areas subject to heavy rainfall within three hours after initial application.
   b. Maintain continuity of coating and repair damage during curing period.

I. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces utilizing final curing methods per ACI 308.1,.
1. Immediately after conclusion of concrete finishing operations, cure newly placed concrete slabs to receive exterior concrete penetrating sealer, interior concrete penetrating sealer/hardener, ceramic tile, or quarry tile or other subsequent flooring finishes or treatments in accordance with ACI 308.1 utilizing one or a combination of the following methods.
   a. Water Cure: Cure continuously for seven days utilizing sprinklers, soaker hoses, ponding, or fog spray. Take care to prevent erosion damage to the surface of the concrete.

b. Absorbent Cover: water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers when placing. Provide continuous supply of moisture such as sprinklers or soaker hoses when high temperature, low humidity, or windy conditions prevail. Do not allow Absorbent Cover materials to dry out during specified curing period.

c. Moisture Retaining Cover with Fabric Curing: Cover concrete surfaces with moisture-retaining cover meeting ASTM C171 as soon as possible after final finishing without marring the surface. Place in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. On flat surfaces such as pavements, the cover shall extend beyond the edges of the slab at least twice the thickness of the slab. The cover shall be placed flat on the concrete surface, avoiding wrinkles, to minimize mottling immediately after wetting the slab to rejection. It shall be placed and weighted so that it remains in contact with the concrete during the specified duration of curing. Windrows of sand or earth, or pieces of lumber shall be placed along all edges and joints in the film to retain moisture and prevent wind from getting under the film and displacing it. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
    1) Moisture Retaining Fabric shall be installed in accordance with manufacture’s written recommendations, in largest practical widths. Wet the slab to rejection then thoroughly wet fabric side of cover and install with poly side up. Lap over adjacent covers a minimum 18”. Weight all laps and outside edges to prevent displacement and to ensure intimate contact with concrete and adjacent covers. Rewet as necessary and protect covers from damage during curing process.

d. Floors to Receive Curing Compound:
    1) Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions. Ensure complete and even coverage on surface of concrete, which may require multiple coats at right angles to one another.
    2) Follow manufacturers recommendations on timing of application to the concrete surface in relation to presence of bleed water and water sheen on surface.
    3) Recoat areas subjected to heavy rainfall within three hours after initial application.
    4) Maintain continuity of coating, protect surfaces from other trades, and repair damage during curing period.
    5) Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project.

3.11 FLOOR TREATMENT

A. Liquid Sealer Densifier Finish: Apply this compound on exposed interior floors as indicated on the drawings. Application shall be made in strict accordance with the directions of the manufacturer and just prior to completion of construction. Spray, squeegee or roll on liquid densifier to clean, dry concrete surface. The liquid should be scrubbed into the surface with a mechanical scrubber. Keep the surface wet with the densifier during the application process. When the product thickens, but not more than 60 minutes after initial application, the surface shall then be squeegeed or vacuumed to remove all excess liquid.

B. Concrete must be a minimum 28 days old, dry, clean, and free of loose dust, dirt, oil, and traces of curing compounds or any other surface contaminations that could interfere with bond of coating.
    1. Close spaces in which sealer is being applied to traffic, and keep closed 48 hours minimum after last application is completed.
    2. Prepare substrate in accordance with manufacturer’s instructions.
    3. Apply a final finish coat within the recommended recoat time. Apply at approximately 700 to 800 sq. ft. per gallon and buff into surface with a high-speed burnisher

3.12 EXISTING WORK

A. Where new concrete is dowelled to existing work, drill holes in existing concrete, insert steel dowels and pack with non-shrinking grout.

3.13 PATCHING AND CLEANING FORMED SURFACES

A. Patch tie holes and defective areas immediately after form removal.

B. Clean exposed concrete to remove laitance, efflorescence and stains.

C. Rough Form Finish: Patch holes and defects; otherwise leave surfaces with texture imparted by forms.

D. Smooth Form Finish: Patch holes and defects; completely remove fins by rubbing with wood blocks.

3.14 DEFECTIVE CONCRETE

A. Modify or replace concrete not conforming to required lines, details, and elevations.

B. Repair or replace concrete not properly placed or of the specified type.

C. Patch imperfections to match in place concrete.

END OF SECTION

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SECTION 03 3800
POST-TENSIONED CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Post-tensioning material.

B. Accessories.

1.02 RELATED SECTIONS

A. Section 01 33 00 - Submittal Procedures.

B. Section 01 40 00 - Quality Requirements.

C. Section 01 45 33 - Code-Required Special Inspections and Procedures.

D. Section 01 60 00 - Product Requirements.

E. Section 03 20 00 - Concrete Reinforcement.

F. Section 03 30 00 - Cast-in-Place Concrete.

G. Section 07 92 00 - Joint Sealants.

H. Section 09 65 66 - Resilient Athletic Sports Surfaces.

1.03 REFERENCES

A. ACI 301 - Specifications for Concrete Construction (ACI 301-20); Current Edition.

B. ACI 318 - Building Code Requirements for Structural Concrete (ACI 318-19) Commentary on Building Code Requirements for Structural Concrete (ACI 318R-19); Current Edition.

C. ACI MNL-66 - ACI Detailing Manual; 2020.

D. ACI PRC-347 - Guide to Formwork for Concrete; 2014 (Reapproved 2021).

E. ASTM A416/A416M - Standard Specification for Low-Relaxation, Seven-Wire Steel Strand for Prestressed Concrete; 2018.

F. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2023.

G. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2024.

H. ASTM E154/E154M - Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover; 2008a (Reapproved 2019).

I. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 2017 (Reapproved 2023).

J. CRSI (DA4) - Manual of Standard Practice; 2023.

K. PTI M10.2 - Specification for Unbonded Single Strand Tendons; 2017.

1.04 SYSTEM DESCRIPTION

A. Post-tensioned Concrete: Design, engineer and construct post-tensioned concrete to meet design and code requirements, so that resultant concrete conforms to required shapes, lines, and dimensions.

B. Fully encapsulated system.

1.05 SLOPE AND ELEVATION REQUIREMENTS

A. All excavating, filling and grading requirements and compacting work of the sub-base should be performed so that the finished sub-grade is 5” (or as specified in geotechnical report) below the surrounding ground.

1.06 SUBMITTALS

A. Material and Equipment Submittals: Submit the following under provisions of Section 01 33 00:
   1. Mix Design: Per section 03 30 00.

2. Certification of compliance for each material furnished stating that material conforms to acceptable ASTM standards.
3. Shop Drawings showing tendon sizes, grouping, spacing, placing sequence, supports and locations, (tendon supports, accessories, supplemental reinforcement, clearances required for jack, and pressure plate stresses calculations of friction and anchorage stresses
    a. Shop Drawings shall include comprehensive engineering analysis, signed and sealed by a qualified professional engineer, registered in the State of the project, responsible for their preparation.
    b. Comprehensive engineering analysis shall be submitted concurrently with related shop drawings.
    c. The supplier's structural engineer shall review field reports and stressing records for compliance with the calculated effective post· tensioning forces, and acknowledge in writing. If it appears that less force has been provided, they shall supply the Engineer/Architect with the actual effective force and optional remedial steps.
4. Describe tensioning sequence, type of jack, pressure monitoring devices, anchorage set, tendon elongation, and tendon cutoff procedures. Indicate formwork methods, materials, arrangement of joints, ties, and shores, location of bracing and temporary supports, and schedule of erection and stripping. Tendon manufacturer's certificate that tendon strength meet or exceed specified requirements. Prepare stressing records during the tensioning, operation, with the following data recorded as a minimum.
    a. Tendon mark or identification.
    b. Calculated elongation.
    c. Gauge pressure to achieve calculated elongation.
    d. Actual elongation achieved.
    e. Actual gauge pressure.
    f. Date of stressing operation.
    g. Signature of the stressing operator or inspector.
    h. Serial or identification number of jacking equipment.
5. Submit certified mill test reports for each coil or pack of strand for review before beginning construction
6. Turn over stressing records to submitted to General Contractor for review by architect and structural engineer.
7. Procurement:
    a. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
    b. Submit inventory to Owner within 5 days of delivery of materials.
    c. See Sections 01 33 00 and 01 60 00.
8. Perform and submit reports of Code Required Special Inspections as required in Section 01 45 33.

1.07 QUALITY ASSURANCE

A. Perform work in accordance with ACI 301, ACI 318, ACI MNL-66, ACI PRC-347, PTI M10.2 and CRSI (DA4) except where more stringent requirements are shown on Drawings.

B. Maintain a copy of ACI 301 on site.

C. Cast-in-place Concrete: Obtain materials from the same source throughout the Work.

D. Fabricator qualifications: Not less than 5 years experience in the actual production of specified products.

E. Installer: Company specializing in post tensioning work with 5 years experience. Ironworker foreman shall have 5 years previous experience with slab and beam projects.

F. Pre-PT Review meeting:
1. This Pre-PT Pour Review is mandatory and no concrete shall be poured for post-tensioned slabs until all conference criteria have been met to the satisfaction of the Design Team.

2. At least 7 days prior to the start of the PT concrete slab prep, the contractor shall conduct a virtual meeting to review and discuss the required methods and procedures to achieve the required concrete construction. A pre-concrete conference agenda shall be distributed to all attendees 3 days prior to the scheduled date of the conference. The following shall be in attendance:
    a. Concrete supplier.
    b. Concrete Sub Contractor.
    c. Independent Testing Laboratory.
    d. LifeTime Structural Engineer.
    e. LifeTime Architect.
    f. Construction Manager.
3. Minutes of the meeting shall be recorded, typed and printed by the contractor and distributed by the contractor to all parties concerned within 5 days of the meeting. One copy of the minutes shall also be transmitted to the following for information purposes: Owner's representative - Resident engineer - Consultant engineer.
4. The minutes shall include a statement by the concrete contractor indicating that the proposed mix design, and pad prep, placing, finishing and curing procedures can produce the concrete quality required by these specifications.
5. The Project Architect, Structural Engineer of Record and Associate Structural Engineer/Field Engineer shall have the option to be present at the conference.
6. The Contractor shall notify the Design Team at least 7 days prior to the scheduled date of the conference.

G. Post-tensioning tendon, anchors, and accessories: Installed and tensioned under the direct full-time supervision of a qualified technical representative of the supplier.

H. Placement of post-tensioning tendons, anchors, and accessories: Coordinated with the placement of non-prestressed reinforcement.

I. Inspection agency to submit written reports as required in Section 01 45 33, the Drawings and the 2015 IBC, within 72 hours.

PART 2 PRODUCTS

2.01 FORM MATERIALS

A. Formwork: In accordance with Section 03 30 00.

2.02 SHEATHING

A. Sheathing material for unbounded single strand tendons:
    1. Sufficient strength to prevent damage during fabrication, transport, installation, concrete placement, and tensioning.
    2. Watertight over entire length.
    3. Chemically stable, without embrittlement or softening over expected exposure temperature range and service life of the structure.
    4. Non-reactive with concrete, steel and tendon corrosion preventative coating.
    5. Colored to contrast with grease and steel so tears are readily visible. Black, brown, or clear sheathing are not acceptable.

B. Thickness: 0.050 inch minimum for medium or high density polyethylene or polypropylene.

C. Inside diameter: 0.010 inch greater than maximum strand diameter.

D. Connect the sheathing for all slab tendons to all stressing, intermediate and fixed anchorages in a watertight fashion, thus providing a complete encapsulation of the pre stressing steel. The encapsulating device must overlap the sheathing a minimum of 1 inch.

2.03 INTEGRAL JOINT MATERIALS

A. Joint Materials: In accordance with Section 03 30 00.

2.04 SEALANTS

A. Sealant and Primer: Specified in Section 07 92 00.

2.05 CONCRETE MATERIALS

A. Concrete Materials: In accordance with Section 03 30 00.

2.06 CONCRETE MIX

A. Concrete Mix: In accordance with Section 03 30 00.

2.07 ACCESSORIES

A. Vapor Retarder: Provide flexible, preformed polyethylene sheet membrane having a water vapor permeance rate no greater than .012 perms when tested in accordance with ASTM E154/E154M, Section 7 and otherwise conforming to the requirements of ASTM E1745, Class A.
   1. Barrier-Bac, Inc., VB-250 (11 mil).
   2. Substitutions: Under provisions of Section 01 60 00.

2.08 CURING MATERIALS

A. Curing: In accordance with Section 03 30 00.

2.09 POST-TENSIONING

A. Post-tensioning material should consist of seven wire stress-relieved strands, conforming to ASTM A416/A416M, with an ultimate strength of 270 KSI. Strands should be coated with a permanent rust preventative lubricant and wrapped with plastic sheathing. If strand sheathing is damaged or removed, it is to be repaired by taping. A maximum of 6” exposed strand is permitted at the anchor. End anchorage devices will conform to Post-tensioning Institute (PTI) specifications. All dead end anchorages must be power seated. All strands are to be supported on chairs and tied at all intersections or securely supported to prevent vertical and horizontal movement during concrete placement. Cables should be laid out in grids no greater than 4 ft on center. Concrete must be well consolidated, especially in the vicinity of strand anchorages. Do not tension tendons above 85% of the tensile strength of the strand. A 9” diameter centered on the strand axis by a 36” length should be allowed for stressing equipment clearance. The stressing process generates tremendous pressures and extreme care should be taken to prevent injury from operator error or failure of equipment or materials.

B. Slabs should be designed using acceptable engineering practices in accordance with the American Concrete Institute Building Code requirements for reinforced concrete and the Post-Tensioning Institute’s tentative specifications for post-tensioning materials. The soil condition and plasticity index of the court site shall be considered in determining strand spacing.

PART 3 EXECUTION

3.01 COORDINATION

A. Ensure all work required to be in place, and furnished by other sections, is coordinated and correctly placed prior to concrete placement.

3.02 FORMWORK INSTALLATION

A. Formwork: In accordance with Section 03 30 00, ASTM C94/C94M, ASTM C33/C33M.

3.03 TENDON PLACEMENT

A. Locate and position tension tendons. Protect from displacement. Protect sheathing from damage; replace if damaged. Verify pre-stressing tendons are firmly supported at intervals not exceeding 3 feet to prevent displacement during concrete placement.

B. Location tolerance from indicated position: 1/4 inch vertically.

C. Horizontal plane deviations necessary to avoid openings, ducts, chases, inserts. Etc. shall have radius of curvature of 21 feet minimum.

D. Secure jack pressure plates in position perpendicular to line of stressing force.

3.04 STRESSING ANCHORAGES

A. Install stressing anchorages perpendicular to tendon axis. Provide tendons free from curvature in the tendon profile 3 feet minimum from stressing anchorage.

B. Attach stressing anchorages to bulkhead forms by bolts, nails, or threaded pocket former fittings. Provide sufficiently rigid connections to avoid accidental loosening due to construction traffic, or during concrete placement. Provide minimum concrete cover for the anchorage of 1 inch at bottom, 1-1/2 inches at top and sides.

C. Provide pocket formers used to provide a void form at stressing and intermediate stressing anchorages that positively preclude intrusion of concrete or cement paste into the wedge cavity during concrete placement. Depth of the pocket former from the edge of the concrete to the face of the anchorage: Not be less than 2 inches at beam tendons and intermediate stressing ends. Pocket former: Not be less than 2 inches deep at the stressing ends.

3.05 INTERMEDIATE ANCHORAGES

A. Intermediate anchorages, if used, shall be installed embedded in concrete.

B. Minimum Cover requirements of stressing anchorages apply to intermediate anchorages.

3.06 FIXED ANCHORAGES

A. Install fixed end anchorages on the tendon at the suppliers plant prior to shipment to the job site.

B. Wedge type anchorages: Seated fixed end wedges, with a load of not more than 80 percent of the minimum ultimate tensile strength of the tendon. Provide sufficient seating load to ensure adequate capacity of non- stressing anchorages.

C. Fixed end anchorages: Place in the formwork at the locations shown on the placing drawings, and securely fasten to the reinforcing steel. Minimum cover requirements of stressing anchorages apply to fixed end anchorages.

3.07 SHEATHING INSPECTION

A. After installing the tendons in the form and prior to concrete casting, inspect sheathing for possible damage.

B. Tendons damaged by inadequate packaging, shipping shall be rejected.

C. Repair any cuts or abrasions which expose the tendon by restoring the corrosion preventive coating in the damaged area, and repairing the sheathing. Verify repairs of sheathing are watertight.

D. Tape used to repair sheathing: Adhesive moisture proof tape, spirally wrapped around the tendon to provide at least 2 layers of tape.

3.08 PLACING CONCRETE

A. Place concrete in accordance with Section 03 30 00.

3.09 POST TENSIONING

A. Begin post tensioning operations after concrete strength has reached 3000 psi compressive strength, but no more than 48 hours after pouring. If the concrete strength has not reached 3000 psi within 48 hours, stress tendons to 1/2 the required force within that time limit. Perform final stressing to full amount specified within 1 week after pour.

B. Confirm concrete strength with test cylinders or in place test prior to stressing.

C. Measure pre-stressing force. Maintain jacking and tensioning records as work progresses.

D. Jack against tendon pressure plate, not against concrete.

E. Cut excess tendon length as soon as possible after tendon tensioning and satisfactory check and approval of stressing records. Tendon length protruding beyond the wedges after cutting: Between 3/4 inch and 1-1/4 inch.

F. Cut tendon by means of oxyacetylene cutting, abrasive wheel, or hydraulic shears. In case of oxyacetylene cutting of the tendon, avoid directing the flame toward the wedges.

G. Fill stressing pockets with Portland cement grout as soon as practical after tendon stressing and cutting. Under no circumstances will the grout or mortar used for pocket filling contain chlorides or other chemical know to be deleterious to the pre-stressing steel.

H. Tendons in the slab; Coat the exposed strand and wedge areas with tendon coating material comparable to that used over the length of the tendon. Apply a watertight cap over the coated area. Prior to installing the pocket mortar, coat the inside concrete surface of the pocket by spraying with a resin bonding agent.

3.10 JOINT INSTALLATION

A. Locate and form expansion control and contraction joints to pattern as shown on Drawings.

B. Place formed construction joints in floor slab pattern placement sequence. Set top screed to required elevations. Secure to resist movement of wet concrete.

C. Install joint fillers and sealants in accordance with manufacturer's instructions. Use primers of type recommended by joint filler and sealant manufacturer.

D. Place concrete continuously between predetermined construction. Do not break or interrupt successive pours such that cold joints occur.

E. Construction Joints:
   1. Joints not shown on Drawings to be located so as not to impair strength or appearance of structure, as determined by Architect/Engineer.
   2. Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints. Provide dowels where directed.
   3. Roughen and thoroughly clean surface of concrete, remove laitance, and wet surface before placing new concrete against joint. Slush vertical joints with neat cement grout immediately before placing new concrete.

3.11 CONCRETE PLACEMENT

A. Inspection:
   1. Verify formwork, anchors, seats, plates, reinforcement, and other items to be cast into concrete are accurately placed, held securely, and will not cause hardship in placing concrete.
   2. Verify required inspections have been performed.
   3. The use of the LTF CONSTRUCTION POUR CARD is a requirement before pouring, and before payment is to be issued. This subcontractor must get this approval before pouring, without approval this subcontractor will bear all responsibility (of their work) for repair, demolition, delays and etc. This is a protection device initiated to eliminate mistakes by all parties involved prior to concrete placement.

B. Preparation:
   1. Thoroughly clean forms before placing concrete. Dampen masonry and porous earth in contact with concrete. Do not place concrete on water or frozen ground.
   2. Prepare previously placed concrete by cleaning with steel brush and thoroughly wet and slush with neat cement grout immediately before placing new concrete.

C. Placing Concrete:
   1. Place Concrete in accordance with Section 03 30 00.

3.12 DEFECTIVE CONCRETE

A. Modify or replace concrete not conforming to required lines, details, and elevations In accordance with Section 03 30 00.

3.13 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed under provisions of Section 01 40 00.
   1. See section 03 30 00 for testing and inspection requirements.

3.14 CURING

A. Curing: In accordance with section 03 30 00.

3.15 PROTECTION

A. Protect finished work under provisions of Section 01 60 00.

1. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

END OF SECTION

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SECTION 03 38 00
POST-TENSIONED CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Post-tensioning material.

B. Accessories.

1.02 RELATED SECTIONS

A. Section 01 33 00 - Submittal Procedures.

B. Section 01 40 00 - Quality Requirements.

C. Section 01 45 33 - Code-Required Special Inspections and Procedures.

D. Section 01 60 00 - Product Requirements.

E. Section 03 20 00 - Concrete Reinforcement.

F. Section 03 30 00 - Cast-in-Place Concrete.

G. Section 07 92 00 - Joint Sealants.

H. Section 09 65 66 - Resilient Athletic Sports Surfaces.

1.03 REFERENCES

A. ACI 301 - Specifications for Concrete Construction (ACI 301-20); Current Edition.

B. ACI 318 - Building Code Requirements for Structural Concrete (ACI 318-19) Commentary on Building Code Requirements for Structural Concrete (ACI 318R-19); Current Edition.

C. ACI MNL-66 - ACI Detailing Manual; 2020.

D. ACI PRC-347 - Guide to Formwork for Concrete; 2014 (Reapproved 2021).

E. ASTM A416/A416M - Standard Specification for Low-Relaxation, Seven-Wire Steel Strand for Prestressed Concrete; 2018.

F. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2023.

G. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2024.

H. ASTM E154/E154M - Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover; 2008a (Reapproved 2019).

I. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 2017 (Reapproved 2023).

J. CRSI (DA4) - Manual of Standard Practice; 2023.

K. PTI M10.2 - Specification for Unbonded Single Strand Tendons; 2017.

1.04 SYSTEM DESCRIPTION

A. Post-tensioned Concrete: Design, engineer and construct post-tensioned concrete to meet design and code requirements, so that resultant concrete conforms to required shapes, lines, and dimensions.

B. Fully encapsulated system.

1.05 SLOPE AND ELEVATION REQUIREMENTS

A. All excavating, filling and grading requirements and compacting work of the sub-base should be performed so that the finished sub-grade is 5” (or as specified in geotechnical report) below the surrounding ground.

1.06 SUBMITTALS

A. Material and Equipment Submittals: Submit the following under provisions of Section 01 33 00:
   1. Mix Design: Per section 03 30 00.

2. Certification of compliance for each material furnished stating that material conforms to acceptable ASTM standards.
3. Shop Drawings showing tendon sizes, grouping, spacing, placing sequence, supports and locations, (tendon supports, accessories, supplemental reinforcement, clearances required for jack, and pressure plate stresses calculations of friction and anchorage stresses
    a. Shop Drawings shall include comprehensive engineering analysis, signed and sealed by a qualified professional engineer, registered in the State of the project, responsible for their preparation.
    b. Comprehensive engineering analysis shall be submitted concurrently with related shop drawings.
    c. The supplier's structural engineer shall review field reports and stressing records for compliance with the calculated effective post· tensioning forces, and acknowledge in writing. If it appears that less force has been provided, they shall supply the Engineer/Architect with the actual effective force and optional remedial steps.
4. Describe tensioning sequence, type of jack, pressure monitoring devices, anchorage set, tendon elongation, and tendon cutoff procedures. Indicate formwork methods, materials, arrangement of joints, ties, and shores, location of bracing and temporary supports, and schedule of erection and stripping. Tendon manufacturer's certificate that tendon strength meet or exceed specified requirements. Prepare stressing records during the tensioning, operation, with the following data recorded as a minimum.
    a. Tendon mark or identification.
    b. Calculated elongation.
    c. Gauge pressure to achieve calculated elongation.
    d. Actual elongation achieved.
    e. Actual gauge pressure.
    f. Date of stressing operation.
    g. Signature of the stressing operator or inspector.
    h. Serial or identification number of jacking equipment.
5. Submit certified mill test reports for each coil or pack of strand for review before beginning construction
6. Turn over stressing records to submitted to General Contractor for review by architect and structural engineer.
7. Procurement:
    a. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
    b. Submit inventory to Owner within 5 days of delivery of materials.
    c. See Sections 01 33 00 and 01 60 00.
8. Perform and submit reports of Code Required Special Inspections as required in Section 01 45 33.

1.07 QUALITY ASSURANCE

A. Perform work in accordance with ACI 301, ACI 318, ACI MNL-66, ACI PRC-347, PTI M10.2 and CRSI (DA4) except where more stringent requirements are shown on Drawings.

B. Maintain a copy of ACI 301 on site.

C. Cast-in-place Concrete: Obtain materials from the same source throughout the Work.

D. Fabricator qualifications: Not less than 5 years experience in the actual production of specified products.

E. Installer: Company specializing in post tensioning work with 5 years experience. Ironworker foreman shall have 5 years previous experience with slab and beam projects.

F. Pre-PT Review meeting:
1. This Pre-PT Pour Review is mandatory and no concrete shall be poured for post-tensioned slabs until all conference criteria have been met to the satisfaction of the Design Team.

2. At least 7 days prior to the start of the PT concrete slab prep, the contractor shall conduct a virtual meeting to review and discuss the required methods and procedures to achieve the required concrete construction. A pre-concrete conference agenda shall be distributed to all attendees 3 days prior to the scheduled date of the conference. The following shall be in attendance:
    a. Concrete supplier.
    b. Concrete Sub Contractor.
    c. Independent Testing Laboratory.
    d. LifeTime Structural Engineer.
    e. LifeTime Architect.
    f. Construction Manager.
3. Minutes of the meeting shall be recorded, typed and printed by the contractor and distributed by the contractor to all parties concerned within 5 days of the meeting. One copy of the minutes shall also be transmitted to the following for information purposes: Owner's representative - Resident engineer - Consultant engineer.
4. The minutes shall include a statement by the concrete contractor indicating that the proposed mix design, and pad prep, placing, finishing and curing procedures can produce the concrete quality required by these specifications.
5. The Project Architect, Structural Engineer of Record and Associate Structural Engineer/Field Engineer shall have the option to be present at the conference.
6. The Contractor shall notify the Design Team at least 7 days prior to the scheduled date of the conference.

G. Post-tensioning tendon, anchors, and accessories: Installed and tensioned under the direct full-time supervision of a qualified technical representative of the supplier.

H. Placement of post-tensioning tendons, anchors, and accessories: Coordinated with the placement of non-prestressed reinforcement.

I. Inspection agency to submit written reports as required in Section 01 45 33, the Drawings and the 2015 IBC, within 72 hours.

PART 2 PRODUCTS

2.01 FORM MATERIALS

A. Formwork: In accordance with Section 03 30 00.

2.02 SHEATHING

A. Sheathing material for unbounded single strand tendons:
    1. Sufficient strength to prevent damage during fabrication, transport, installation, concrete placement, and tensioning.
    2. Watertight over entire length.
    3. Chemically stable, without embrittlement or softening over expected exposure temperature range and service life of the structure.
    4. Non-reactive with concrete, steel and tendon corrosion preventative coating.
    5. Colored to contrast with grease and steel so tears are readily visible. Black, brown, or clear sheathing are not acceptable.

B. Thickness: 0.050 inch minimum for medium or high density polyethylene or polypropylene.

C. Inside diameter: 0.010 inch greater than maximum strand diameter.

D. Connect the sheathing for all slab tendons to all stressing, intermediate and fixed anchorages in a watertight fashion, thus providing a complete encapsulation of the pre stressing steel. The encapsulating device must overlap the sheathing a minimum of 1 inch.

2.03 INTEGRAL JOINT MATERIALS

A. Joint Materials: In accordance with Section 03 30 00.

2.04 SEALANTS

A. Sealant and Primer: Specified in Section 07 92 00.

2.05 CONCRETE MATERIALS

A. Concrete Materials: In accordance with Section 03 30 00.

2.06 CONCRETE MIX

A. Concrete Mix: In accordance with Section 03 30 00.

2.07 ACCESSORIES

A. Vapor Retarder: Provide flexible, preformed polyethylene sheet membrane having a water vapor permeance rate no greater than .012 perms when tested in accordance with ASTM E154/E154M, Section 7 and otherwise conforming to the requirements of ASTM E1745, Class A.
   1. Barrier-Bac, Inc., VB-250 (11 mil).
   2. Substitutions: Under provisions of Section 01 60 00.

2.08 CURING MATERIALS

A. Curing: In accordance with Section 03 30 00.

2.09 POST-TENSIONING

A. Post-tensioning material should consist of seven wire stress-relieved strands, conforming to ASTM A416/A416M, with an ultimate strength of 270 KSI. Strands should be coated with a permanent rust preventative lubricant and wrapped with plastic sheathing. If strand sheathing is damaged or removed, it is to be repaired by taping. A maximum of 6" exposed strand is permitted at the anchor. End anchorage devices will conform to Post-tensioning Institute (PTI) specifications. All dead end anchorages must be power seated. All strands are to be supported on chairs and tied at all intersections or securely supported to prevent vertical and horizontal movement during concrete placement. Cables should be laid out in grids no greater than 4 ft on center. Concrete must be well consolidated, especially in the vicinity of strand anchorages. Do not tension tendons above 85% of the tensile strength of the strand. A 9" diameter centered on the strand axis by a 36" length should be allowed for stressing equipment clearance. The stressing process generates tremendous pressures and extreme care should be taken to prevent injury from operator error or failure of equipment or materials.

B. Slabs should be designed using acceptable engineering practices in accordance with the American Concrete Institute Building Code requirements for reinforced concrete and the Post-Tensioning Institute's tentative specifications for post-tensioning materials. The soil condition and plasticity index of the court site shall be considered in determining strand spacing.

PART 3 EXECUTION

3.01 COORDINATION

A. Ensure all work required to be in place, and furnished by other sections, is coordinated and correctly placed prior to concrete placement.

3.02 FORMWORK INSTALLATION

A. Formwork: In accordance with Section 03 30 00, ASTM C94/C94M, ASTM C33/C33M.

3.03 TENDON PLACEMENT

A. Locate and position tension tendons. Protect from displacement. Protect sheathing from damage; replace if damaged. Verify pre-stressing tendons are firmly supported at intervals not exceeding 3 feet to prevent displacement during concrete placement.

B. Location tolerance from indicated position: 1/4 inch vertically.

C. Horizontal plane deviations necessary to avoid openings, ducts, chases, inserts. Etc. shall have radius of curvature of 21 feet minimum.

D. Secure jack pressure plates in position perpendicular to line of stressing force.

3.04 STRESSING ANCHORAGES

A. Install stressing anchorages perpendicular to tendon axis. Provide tendons free from curvature in the tendon profile 3 feet minimum from stressing anchorage.

B. Attach stressing anchorages to bulkhead forms by bolts, nails, or threaded pocket former fittings. Provide sufficiently rigid connections to avoid accidental loosening due to construction traffic, or during concrete placement. Provide minimum concrete cover for the anchorage of 1 inch at bottom, 1-1/2 inches at top and sides.

C. Provide pocket formers used to provide a void form at stressing and intermediate stressing anchorages that positively preclude intrusion of concrete or cement paste into the wedge cavity during concrete placement. Depth of the pocket former from the edge of the concrete to the face of the anchorage: Not be less than 2 inches at beam tendons and intermediate stressing ends. Pocket former: Not be less than 2 inches deep at the stressing ends.

3.05 INTERMEDIATE ANCHORAGES

A. Intermediate anchorages, if used, shall be installed embedded in concrete.

B. Minimum Cover requirements of stressing anchorages apply to intermediate anchorages.

3.06 FIXED ANCHORAGES

A. Install fixed end anchorages on the tendon at the suppliers plant prior to shipment to the job site.

B. Wedge type anchorages: Seated fixed end wedges, with a load of not more than 80 percent of the minimum ultimate tensile strength of the tendon. Provide sufficient seating load to ensure adequate capacity of non- stressing anchorages.

C. Fixed end anchorages: Place in the formwork at the locations shown on the placing drawings, and securely fasten to the reinforcing steel. Minimum cover requirements of stressing anchorages apply to fixed end anchorages.

3.07 SHEATHING INSPECTION

A. After installing the tendons in the form and prior to concrete casting, inspect sheathing for possible damage.

B. Tendons damaged by inadequate packaging, shipping shall be rejected.

C. Repair any cuts or abrasions which expose the tendon by restoring the corrosion preventive coating in the damaged area, and repairing the sheathing. Verify repairs of sheathing are watertight.

D. Tape used to repair sheathing: Adhesive moisture proof tape, spirally wrapped around the tendon to provide at least 2 layers of tape.

3.08 PLACING CONCRETE

A. Place concrete in accordance with Section 03 30 00.

3.09 POST TENSIONING

A. Begin post tensioning operations after concrete strength has reached 3000 psi compressive strength, but no more than 48 hours after pouring. If the concrete strength has not reached 3000 psi within 48 hours, stress tendons to 1/2 the required force within that time limit. Perform final stressing to full amount specified within 1 week after pour.

B. Confirm concrete strength with test cylinders or in place test prior to stressing.

C. Measure pre-stressing force. Maintain jacking and tensioning records as work progresses.

D. Jack against tendon pressure plate, not against concrete.

E. Cut excess tendon length as soon as possible after tendon tensioning and satisfactory check and approval of stressing records. Tendon length protruding beyond the wedges after cutting: Between 3/4 inch and 1-1/4 inch.

F. Cut tendon by means of oxyacetylene cutting, abrasive wheel, or hydraulic shears. In case of oxyacetylene cutting of the tendon, avoid directing the flame toward the wedges.

G. Fill stressing pockets with Portland cement grout as soon as practical after tendon stressing and cutting. Under no circumstances will the grout or mortar used for pocket filling contain chlorides or other chemical know to be deleterious to the pre-stressing steel.

H. Tendons in the slab; Coat the exposed strand and wedge areas with tendon coating material comparable to that used over the length of the tendon. Apply a watertight cap over the coated area. Prior to installing the pocket mortar, coat the inside concrete surface of the pocket by spraying with a resin bonding agent.

3.10 JOINT INSTALLATION

A. Locate and form expansion control and contraction joints to pattern as shown on Drawings.

B. Place formed construction joints in floor slab pattern placement sequence. Set top screed to required elevations. Secure to resist movement of wet concrete.

C. Install joint fillers and sealants in accordance with manufacturer's instructions. Use primers of type recommended by joint filler and sealant manufacturer.

D. Place concrete continuously between predetermined construction. Do not break or interrupt successive pours such that cold joints occur.

E. Construction Joints:
   1. Joints not shown on Drawings to be located so as not to impair strength or appearance of structure, as determined by Architect/Engineer.
   2. Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints. Provide dowels where directed.
   3. Roughen and thoroughly clean surface of concrete, remove laitance, and wet surface before placing new concrete against joint. Slush vertical joints with neat cement grout immediately before placing new concrete.

3.11 CONCRETE PLACEMENT

A. Inspection:
   1. Verify formwork, anchors, seats, plates, reinforcement, and other items to be cast into concrete are accurately placed, held securely, and will not cause hardship in placing concrete.
   2. Verify required inspections have been performed.
   3. The use of the LTF CONSTRUCTION POUR CARD is a requirement before pouring, and before payment is to be issued. This subcontractor must get this approval before pouring, without approval this subcontractor will bear all responsibility (of their work) for repair, demolition, delays and etc. This is a protection device initiated to eliminate mistakes by all parties involved prior to concrete placement.

B. Preparation:
   1. Thoroughly clean forms before placing concrete. Dampen masonry and porous earth in contact with concrete. Do not place concrete on water or frozen ground.
   2. Prepare previously placed concrete by cleaning with steel brush and thoroughly wet and slush with neat cement grout immediately before placing new concrete.

C. Placing Concrete:
   1. Place Concrete in accordance with Section 03 30 00.

3.12 DEFECTIVE CONCRETE

A. Modify or replace concrete not conforming to required lines, details, and elevations In accordance with Section 03 30 00.

3.13 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed under provisions of Section 01 40 00.
   1. See section 03 30 00 for testing and inspection requirements.

3.14 CURING

A. Curing: In accordance with section 03 30 00.

3.15 PROTECTION

A. Protect finished work under provisions of Section 01 60 00.

1. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

END OF SECTION

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SECTION 03 4100
PRECAST STRUCTURAL CONCRETE

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes the performance criteria, materials, design, production, and erection of structural precast and precast, pre-stressed concrete with a commercial architectural (CA) finish for the entire project. The work performed under this Section includes all labor, material, equipment, related services, and supervision required for the manufacture and erection of the structural precast and precast, pre-stressed concrete work shown on the Contract Drawings.

B. This Section includes the following:
   1. Insulated precast wall panels.
   2. Non-insulated precast wall panels.
   3. Solid slab units.
   4. Precast Stairs.

C. This Section includes the following with a commercial architectural (CA) finish:
   1. Spandrels.
   2. Walls.
   3. Insulated Walls.

1.02 RELATED SECTIONS:

A. Section 01 31 00 - Project Management and Coordination.

B. Section 01 33 00 - Submittal Procedures

C. Section 01 40 00 - Quality Requirements

D. Section 01 45 33 - Code-Required Special Inspections and Procedures.

E. Section 01 60 00 - Product Requirements.

F. Section 03 30 00 - Cast-in-Place Concrete for installing connection anchors and reinforcing steel in concrete and structural topping.

G. Section 03 45 00 - Architectural Precast Concrete.

H. Section 04 20 00 - Unit Masonry Assemblies for inserts or anchorages required.

I. Section 05 12 00 - Structural Steel Framing for furnishing and installing connections attached to structural-steel framing.

J. Section 05 50 00 - Metal Fabrications for furnishing and installing loose hardware items.

K. Section 07 21 00 - Thermal Insulation for insulation to meet energy code.

L. Section 07 62 00 - Sheet Metal Flashing and Trim for flashing receivers and reglets.

M. Section 07 84 00 - Firestop for joint filler materials for fire-resistance-rated construction.

N. Section 07 92 00 - Joint Sealants for elastomeric joint sealants and sealant backings between slab edges at exposed underside of floor and roof members and/or perimeter of members.

O. Section 07 95 00 - “Preformed Traffic Durable Sealant Systems.” [for parking decks only]

1.03 REFERENCE STANDARDS

A. AASHTO LRFD - Bridge Design Specifications; 2024.

B. AASHTO M251 - Standard Specification for Plain and Laminated Elastomeric Bridge Bearings; Current Edition.

C. ACI 318 - Building Code Requirements for Structural Concrete (ACI 318-19) Commentary on Building Code Requirements for Structural Concrete (ACI 318R-19); Current Edition.

D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

E. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished; 2018.

F. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

G. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.

H. ASTM A184/A184M - Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement; 2019.

I. ASTM A193/A193M - Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications; 2024a.

J. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2018.

K. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.

L. ASTM A416/A416M - Standard Specification for Low-Relaxation, Seven-Wire Steel Strand for Prestressed Concrete; 2018.

M. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2023.

N. ASTM A563/A563M - Standard Specification for Carbon and Alloy Steel Nuts (Inch and Metric); 2021a.

O. ASTM A572/A572M - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel; 2021, with Editorial Revision.

P. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2022.

Q. ASTM A675/A675M - Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties; 2014 (Reapproved 2019).

R. ASTM A706/A706M - Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement; 2022a.

S. ASTM A767/A767M - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement; 2019.

T. ASTM A775/A775M - Standard Specification for Epoxy-Coated Steel Reinforcing Bars; 2022.

U. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2020.

V. ASTM A886/886M - Standard Specification for Steel Strand, Indented, Seven-Wire Stress-Relieved for Prestressed Concrete; Current edition.

W. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2022.

X. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2023.

Y. ASTM C42/C42M - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete; 2018.

Z. ASTM C67/C67M - Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile; 2023.

AA. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2018.

BB. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.

CC. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete; 2010a (Reapproved 2016).

DD. ASTM C330/C330M - Standard Specification for Lightweight Aggregates for Structural Concrete; 2023.

EE. ASTM C404 - Standard Specification for Aggregates for Masonry Grout; 2024.

FF. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2019, with Editorial Revision (2022).

GG. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2023.

HH. ASTM C618 - Standard Specification for Coal Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2023, with Editorial Revision.

II. ASTM C881/C881M - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete; 2020a.

JJ. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete; 2016.

KK. ASTM C989/C989M - Standard Specification for Slag Cement for Use in Concrete and Mortars; 2024.

LL. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2020.

MM. ASTM C1218/C1218M - Standard Test Method for Water-Soluble Chloride in Mortar and Concrete; Current edition.

NN. ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures; 2020.

OO. ASTM C1610/C1610M - Standard Test Method for Static Segregation of Self-Consolidating Concrete Using Column Technique; Current edition.

PP. ASTM C1611 - Standard Test Method for Slump Flow of Self-Consolidating Concrete; 2021.

QQ. ASTM C1621/C1621M - Standard Test Method for Passing Ability of Self-Consolidating Concrete by J-Ring; Current edition.

RR. ASTM C1712 - Standard Test Method for Rapid Assessment of Static Segregation Resistance of Self-Consolidating Concrete Using Penetration Test; Current edition.

SS. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2016 (Reapproved 2021).

TT. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness; 2015 (Reapproved 2021).

UU. ASTM E165/E165M - Standard Practice for Liquid Penetrant Testing for General Industry; 2023.

VV. ASTM E543 - Standard Specification for Agencies Performing Nondestructive Testing; 2021.

WW. ASTM F436/F436M - Standard Specification for Hardened Steel Washers Inch and Metric Dimensions; 2019.

XX. ASTM F2329/F2329M - Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners; Current edition.

YY. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2023.

ZZ. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).

AAA. AWS D1.4/D1.4M - Structural Welding Code - Steel Reinforcing Bars; 2018, with Amendment (2020).

BBB. AWS D1.6/D1.6M - Structural Welding Code - Stainless Steel; 2017, with Amendment (2021).

CCC. PCI (CERT) - PCI Plant Certification; Current Edition.

DDD. PCI MNL-116 - Manual for Quality Control for Plants and Production of Structural Precast Concrete Products; 2021.

EEE. PCI MNL-120 - PCI Design Handbook; 2017, with Errata (2021).

FFF. PCI MNL-124 - Design for Fire Resistance of Precast Prestressed Concrete; 2011.

GGG. PCI MNL-135 - Tolerance Manual for Precast and Prestressed Concrete Construction; 2000.

HHH. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate opening sizes and locations, attachment of related items, and other work related to the fabrication and installation of precast concrete units, including the following:
   1. Cast-in Electrical Devices: Cast-in Electrical Devices: Coordinate the location of cast-in electrical conduit and junction boxes. Provide panel layout drawings and elevations to Electrical Contractor a minimum of one week prior to casting. Notify Electrical Contractor a minimum of 48 hours prior to casting so they can travel to site and provide and install electrical items in casting forms.
   2. Mechanical and Plumbing Penetrations.

B. Sequencing: Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction without delaying the work. Provide setting diagrams, templates, instructions, and directions, as required, for installation.

C. Preinstallation Meeting: Conduct a preinstallation meeting a minimum of two weeks prior to installation of precast concrete. Require attendance of related trades, the Architect and Contractor. Review the following items:
   1. Review approved shop drawings and installation details.
   2. Anchor and weld plate locations.
   3. Opening locations including those cut in the field.
   4. Limitations on field cutting and core drilling.
   5. Site access requirements and obstructions including but not limited:
      a. Access roads and maintenance thereof.
      b. Protection and repair of existing paving.
      c. Dewatering of footing trenches.
      d. Job site snow removal.
      e. Job site debris removal.
      f. Overhead obstructions including power lines.

D. Cold weather grouting requirements and expectations.

E. Cleaning responsibilities and expectation

1.05 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide structural precast concrete members and connections capable of withstanding design loads indicated within limits and under conditions indicated on Drawings.

B. Design structural precast concrete framing system and connections to maintain clearances at openings, to allow for fabrication and construction tolerances, to accommodate live-load deflection, shrinkage and creep of primary building structure, and other building movements. Maintain structural precast concrete deflections within limits of ACI 318 (ACI 318M).Fire Resistance Rating: Provide components to meet the following fire ratings:
   1. Building:
      a. Roof: 1 hr
      b. Exterior Walls: 2 hr
      c. Plank and solid slabs: 2 hr
   2. Thermal Movements: Provide for thermal movements noted.
      a. The precast system design shall consider the maximum seasonal climatic temperature change.
      b. In plane thermal movements of individual members directly exposed to the sun shall consider a temperature range of 50 degrees Fahrenheit.
      c. Member connection design shall consider through thickness thermal gradients as appropriate.
      d. Precaster shall consider the effects of wall panel bow during engineering, fabrication, storage and erection. Precaster shall target means and methods to produce panels with in-

service conditions that are plumb and bow-free. Maximum out-of-plumb tolerance at in-service condition over the height of the overall window frame shall be 3/8”.

1.06 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Retain quality control records and certificates of compliance for 5 years after completion of structure.

B. Design Mixtures: For each precast concrete mixture, include compressive strength.

C. Shop (Erection) Drawings:
   1. Provide signed and sealed drawings by a qualified professional engineer responsible for its preparation licensed in the state of the project.
   2. Detail fabrication and installation of structural precast concrete units including connections at member ends and to each adjoining member.
   3. Indicate locations, plan views, elevations, dimensions, shapes, and cross sections of each unit, openings, support conditions and types of reinforcement, including special reinforcement.
   4. Indicate aesthetic intent including joints, rustications or reveals, and extent and location of each surface finish.
   5. Indicate welded connections by AWS standard symbols. Show size, length, and type of each weld.
   6. Detail loose and cast-in hardware, lifting and erection inserts, connections, and joints.
   7. Indicate locations and details of anchorage devices to be embedded in or attached to structure or other construction.
   8. Include and locate openings larger than 8 in. Where additional structural support is required for openings include header design.
   9. Coordinate and indicate openings and inserts required by other trades.
   10. Indicate locations of and detail lifting and handling devices. Use side or edge devices at all locations to minimize unsightly patching at exposed faces. Any face locations must be preapproved by the Architect.
   11. Indicate sections and details showing quantities and position of reinforcing steel and related items including special reinforcement.
   12. Indicate locations of and detail solid concrete and reduced insulation zones. These types of zones are unacceptable unless absolutely necessary and must be preapproved by Contractor and Architect prior to fabrication.
   13. Indicate location of each structural precast concrete member by same identification mark placed on unit.
   14. Indicate relationship of structural precast concrete members to adjacent materials.
   15. Indicate locations and details of joint treatment.
   16. Indicate areas receiving toppings and magnitude of topping thickness.
   17. Indicate estimated cambers for floor slabs receiving cast-in-place topping.
   18. Indicate multiple wythe connection devices.
   19. Indicate shim sizes and grouting sequence.
   20. Design Modifications:
      a. If design modifications are proposed to meet performance requirements and field conditions, notify the Architect and submit design calculations and Shop Drawings.
      b. Do not affect the appearance, durability or strength of members when modifying details or materials. Maintain the general design concept when altering size of members and alignment.

D. Engineering Analysis:
   1. Provide comprehensive structural analysis design data signed and sealed by qualified professional engineer, registered in the state of the project, responsible for their preparation.
   2. Calculations shall be submitted concurrently with shop/erection drawings and shall be signed and sealed at time of submission.

E. Erection Plan: The plan shall include temporary connection such as shoring, guying, bracing, and specific erection sequence requirements. At a minimum the temporary structural system shall be

capable of resisting a 10 psf (working load) lateral load in any direction applied to the projected area of such members/system under consideration. The erection plan shall be signed and sealed a registered engineer in the state of the project.

F. Samples: Design reference samples for initial verification of design intent, approximately 12 by 12 by 2 inches (300 by 300 by 50 mm), representative of finishes, colors, and textures of exposed surfaces of structural precast concrete members.
   1. When back face of precast concrete member is to be exposed, include Samples illustrating workmanship, color, and texture of the concrete.

G. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Contractor within 5 days of delivery of materials.
   3. See Sections 01 33 00 and 01 60 00.

1.07 INFORMATIONAL SUBMITTALS

A. Provide the following with bid materials:
   1. Qualification Data: For installer, fabricator and testing agency and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include list of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

B. Welding Certificates: Copies of certificates for welding procedure specifications (WPS) and personnel certification.

C. Material Test Reports for aggregates: From an accredited testing agency, indicating and interpreting test results for compliance with requirements indicated.

D. Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements.
   1. Cementitious materials.
   2. Reinforcing materials and pre-stressing tendons.
   3. Admixtures.
   4. Bearing pads.
   5. Structural-steel shapes and hollow structural sections.
   6. Insulation.
   7. Other components specified in Contract Documents with applicable standards.

E. Field quality-control test and special inspections reports.

1.08 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Single Source Requirement: Provide all precast concrete of this section by one manufacturer.

C. Erector Qualifications: A precast concrete erector with a minimum of 5 years experience in erection of precast concrete similar to the project AND Qualified by the Precast/Pre-stressed Concrete Institute (PCI) prior to beginning work at the jobsite. Submit a current Certificate of Compliance furnished by PCI designating qualification in Category S2 (Complex Structural Systems) for load-bearing members.

D. Erector Certification: A precast concrete erector with erecting organization and all erecting crews Certified and designated, prior to beginning work at project site, by PCI's Certificate of Compliance to erect (Category S2) [Complex Structural Systems] for load-bearing members).

E. Professional Engineer Qualifications: A professional engineer licensed in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of structural precast concrete that are similar to those indicated for this Project in material, design, and extent.

F. Participates in PCI's Plant Certification program and is designated a PCI (CERT) plant for Category AA or AB AND Category C3A – Pre-stressed Straight-Strand Structural Members.

G. Fabricator has sufficient production capacity to produce required members without delaying the Work.

H. Certification shall be maintained throughout the production of the precast concrete units. Production shall immediately stop if at any time the fabricator's certification is revoked, regardless of the status of completion of contracted work. Production will not be allowed to re-start until the necessary corrections are made and certification has been re-established. In the event certification(s) can not be re-established in a timely manner, causing project delays, the fabricator, at no additional cost, will contract out the remainder of the units to be manufactured at a PCI certified plant.

I. Fabricator is registered with and approved by authorities having jurisdiction.

J. Design Standards: Comply with ACI 318 (ACI 318M) and the design recommendations of PCI MNL-120, "PCI Design Handbook – Precast and Pre-stressed Concrete," applicable to types of structural precast concrete members indicated.

K. Quality-Control Standard: For manufacturing procedures and testing requirements and quality control recommendations for types of members required, comply with PCI MNL-116, "Manual for Quality Control for Plants and Production of Structural Concrete Products."

L. Comply with camber and dimensional tolerances of PCI MNL-135, "Tolerance Manual for Precast and Pre-stressed Concrete Construction."

M. Product Options: Drawings indicate size, profiles and dimensional requirements of precast concrete members and are based on the specific types of members indicated. Other fabricators' precast concrete members complying with requirements may be considered prior to bidding. Refer to Division 1 Section "Substitutions."

N. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code – Steel"; AWS D1.4/D1.4M, "Structural Welding Code – Reinforcing Steel"; and AWS D1.6/D1.6M, "Structural Welding Code-Stainless".

O. Fire Resistance: Where indicated, provide structural precast concrete members whose fire resistance satisfy the fire resistance ratings of the Contract Documents and meets the prescriptive requirements of the governing code or has been calculated according to PCI MNL-124, "Design for Fire Resistance of Precast Pre-stressed Concrete," and is acceptable to authorities having jurisdiction.

P. Mockup Control Sample Unit: Provide a mock up panel at the plant, 4 feet by 4 feet in size, for quality comparison of finished unit to an approved appearance sample for color and texture.

Q. Initial Mock Up: After sample approval and before fabricating CA precast concrete members, with architectural finish, thin-brick facing. Produce sample units to establish the approved range of selections made under sample Submittals. Produce a minimum of 2 sample units approximately 4'x8' (1.22m x 2.44m) in area. Incorporate full scale details of architectural features, finishes, textures and transitions in sample units.
   1. Locate units where indicated in Contract Documents or, if not indicated, as directed by Architect.
   2. Damage part of an exposed-face surface for each finish, color, and texture, and demonstrate adequacy of repair techniques proposed for repairs of surface blemishes. Patch an exposed lift loop location.
   3. After acceptance of repair technique, maintain one sample unit at the fabricator's plant and one at the Project site in an undisturbed condition as a standard for judging the completed Work.
   4. Hard trowel and broom finish.
   5. Demolish and remove sample units when directed.

R. Full Size Mockup: After sample panel approval but before production of structural precast concrete units, with architectural finish and thin-brick facing construct full-sized mockup to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution. Mockups to be representative of the finished work in all respects including fabrication tolerances, interior finish, demonstration of patching lifters, thin brick, and precast concrete as accepted on the final Shop Drawings. Build mockups to comply with the following requirements, using materials indicated for the completed work:
   1. Build mockup as indicated in Contract Documents or, if location is not indicated, as directed by Architect.

2. Notify Architect in advance of dates and times when mockups will be constructed.
3. Obtain Architect's approval of mockup before starting fabrication of precast concrete members.
4. Approved mockup may become part of the completed Work if undamaged at the time of Substantial Completion.
5. Approval of mockup does not constitute approval of deviations from the Contract Documents unless such deviations are specifically approved by Architect in writing.

S. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Section 01 31 00 "Project Management and Coordination."

1.09 DELIVERY, STORAGE, AND HANDLING

A. General Requirement: All lifting and handling, transportation and delivery, storage and support, and erection of precast panels to be performed by qualified personnel using methods and equipment approved by manufacturer.

B. Deliver all structural precast concrete members in such quantities and at such times to assure compliance with the agreed upon project schedule and setting sequence to ensure continuity of installation.

C. Handle and transport members in a manner to avoid excessive stresses that could cause cracking or other damage.

D. Store units with adequate dunnage and bracing, and protect units to prevent contact with soil, staining, and to control cracking, distortion, warping or other physical damage.

E. Unless otherwise specified or shown on Shop Drawings, store members with dunnage across full width of each bearing point.

F. Place stored members so identification marks are clearly visible, and units can be inspected.

G. Place dunnage of even thickness between each member.

H. Lift and support members only at designated points indicated on the Shop Drawings.
1. Lift only with methods and equipment approved by Manufacturer.
2. Lifting devices to have a minimum safety factor of 5 to 1.

1.10 FIELD CONDITIONS

A. General Contractor shall prepare and maintain site free of obstructions as required by precast erector for the work of this section.

B. Cold Weather Grouting: Provide written procedures to address cold weather grouting to Contractor/Architect prior to the erection process.

1.11 SEQUENCING

A. Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction without delaying the Work. Provide locations, setting diagrams, templates, instructions, and directions, as required, for installation.

1.12 WARRANTY

A. Provide twelve-month guarantee for workmanship, materials, and satisfactory performance from date of Substantial Completion.

PART 2 PRODUCTS

2.01 PRECAST CONCRETE WALL PANELS

A. Manufacturer: Shall possess qualifications listed above and have been approved by Architect prior to submitting bid.

B. Insulated Wall Panels:
1. Size/Shape/Profile: As indicated on the drawings.
2. Overall Thickness: 12 inch thick unless noted otherwise; 3 inch exterior wythe, 3 inch insulation, and 6 inch Interior Wythe unless noted otherwise. Thickness may change per design requirements.
3. Form Side Architectural Finish: As indicated/scheduled on the drawings, refer to finish

4. Form Side Architectural Color: As indicated/scheduled on the drawings. See below.
5. Screed Side Finish: See Below
6. Screed Side Color: Gray

C. Uninsulated Wall Panels:
1. Size/Shape/Profile: As indicated on the drawings.
2. Overall Thickness:
a. Exterior walls: 8" thick unless noted otherwise.
b. Interior shaft walls: 8" thick unless noted otherwise.
3. Form Side Architectural Finish: As indicated/scheduled on the drawings, refer to finish description types below.
4. Screed Side Finish: See Below
5. Screed Side Color: Gray

2.02 FORM MATERIALS

A. Forms: Rigid, dimensionally stable, non-absorptive material, warp and buckle free, that will provide precast concrete surfaces within fabrication tolerances indicated; nonreactive with concrete and suitable for producing required surface finishes.
1. Form-Release Agent: Commercially produced form-release agent that will not bond with, stain or affect hardening of precast concrete surfaces and will not impair subsequent surface or joint treatments of precast concrete.

2.03 REINFORCING MATERIALS

A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of pre-consumer recycled content is not less than 25 percent.

B. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.

C. Low-Alloy-Steel Reinforcing Bars: ASTM A706/A706M, deformed.

D. Galvanized Reinforcing Bars: ASTM A767/A767M, Class II zinc coated, hot-dip galvanized and chromate wash treated after fabrication and bending.

E. Steel Bar Mats: ASTM A184/A184M, fabricated from , deformed bars, assembled with clips.

F. Plain-Steel Welded Wire Reinforcement: ASTM A1064/A1064M, fabricated from as-drawn steel wire into flat sheets.

G. Deformed-Steel Welded Wire Reinforcement: ASTM A1064/A1064M, flat sheet.

H. Supports: Use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 116.

2.04 PRESTRESSING TENDONS

A. Pre-stressing Strand: ASTM A416/A416M, Grade 270, uncoated, 7-wire, low-relaxation strand or ASTM A886/886M, Grade 270 (Grade 1860), indented, 7-wire, low-relaxation strand (including supplement).

2.05 CONCRETE MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or III u.n.o.
1. For surfaces exposed to view in finished structure, use same type, brand, and mill source throughout the precast concrete production.

B. White Cement. Required for all Architectural Colored concrete.

C. Grey Cement. For all egress stairs, beams, T’s, columns and structural wythes of concrete.

D. Supplementary Cementitious Materials
1. Fly Ash: ASTM C618, Class C or F with maximum loss on ignition of 3%.
2. Metakaolin: ASTM C618, Class N.
3. Silica Fume: ASTM C1240 with optional chemical and physical requirements.
4. Ground Granulated Blast-Furnace Slag: ASTM C989/C989M, Grade 100 or 120.

E. Normal weight Aggregates: Except as modified by PCI MNL 116, ASTM C33/C33M, with coarse, non-reactive aggregates. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.
   1. Face-Mixture Coarse Aggregates: Selected, hard, and durable; free of material that reacts with cement or causes staining; to match selected finish sample.
      a. Gradation: To match approved mock up.
   2. Face-Mixture Fine Aggregates: Selected, natural or manufactured sand of a material compatible with coarse aggregate to match selected Sample finish.

F. Backup Concrete Aggregates: ASTM C33/C33M or ASTM C330/C330M.

G. Lightweight Aggregates: Except as modified by PCI MNL 116, ASTM C330 with absorption less than 11 percent.

H. Coloring Admixture: ASTM C979/C979M, synthetic or natural mineral-oxide pigments or liquid coloring admixtures, temperature stable and non-fading.

I. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 116.

J. Air Entraining Admixture: ASTM C260/C260M, certified by manufacturer to be compatible with other required admixtures.

K. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride, or more than 0.15 percent chloride ions or other salts by weight of admixture.
   1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
   2. Retarding Admixture: ASTM C494/C494M, Type B.
   3. Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type D.
   4. Water-Reducing and Accelerating Admixture ASTM C494/C494M, Type E.
   5. High Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
   6. High-Range, Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type G.
   7. Plasticizing Admixture for Flowable Concrete: ASTM C1017/C1017M.
   8. Corrosion Inhibiting Admixture: ASTM C1582/C1582M

2.06 STEEL CONNECTION MATERIALS

A. Carbon-Steel Shapes and Plates: ASTM A36/A36M

B. Carbon-Steel Headed Studs: ASTM A108, Grades 1010 through 1020, cold finished, AWS D1.1/D1.1M, Type A or B, with arc shields and with the minimum mechanical properties of PCI MNL 116, Table 3.2.3.

C. Carbon-Steel Plate: ASTM A283/A283M, Grade C.

D. Malleable Iron Castings: ASTM A47/A47M. Grade 32510 or 35028.

E. Carbon-Steel Castings: ASTM A27/A27M, Grade 60-30 (Grade 415-205).

F. High-Strength, Low-Alloy Structural Steel: ASTM A572/A572M.

G. Carbon-Steel Structural Tubing: ASTM A500/A500M, Grade B or C.

H. Wrought Carbon-Steel Bars: ASTM A675/A675M, Grade 65 (Grade 450).

I. Deformed-Steel Wire or Bar Anchors: ASTM A706/A706M.

J. Carbon-Steel Bolts and Studs: ASTM A307, Grade A or C (ASTM F568M, Property Class 4.6) carbon-steel, hex-head bolts and studs; carbon-steel nuts (ASTM A563/A563M, Grade A); and flat, unhardened steel washers (ASTM F436/F436M).

K. High-Strength Bolts and Nuts: ASTM A193/A193M, Grade B5 or B7, ASTM F3125/F3125M, Type 1, heavy hex steel structural bolts, heavy hex carbon-steel nuts, (ASTM A563/A563M) and hardened carbon-steel washers (ASTM F436/F436M).

L. Zinc-Coated Finish: For exterior steel items and items indicated for galvanizing, apply zinc coating by hot-dip process according to ASTM A123/A123M, after fabrication, ASTM A153/A153M, or ASTM F2329/F2329M as applicable.
   1. For steel shapes, plates, and tubing to be galvanized, limit silicon content of steel to less than 0.03 percent or to between 0.15 and 0.25 percent or limit sum of silicon content and 2.5 times phosphorous content to 0.09 percent.
   2. Galvanizing Repair Paint: Zinc paint with dry film containing not less than 94 percent zinc dust by weight, and complying with DOD-P-21035B or SSPC-Paint 20.
   3. Bituminous coating: Carboline “Bitumatic No. 50”

2.07 BEARING PADS AND OTHER ACCESSORIES

A. Provide one of the following bearing pads for structural precast concrete members:
   1. Elastomeric Pads: AASHTO M251, plain, vulcanized, 100 percent polychloroprene (neoprene) elastomer, molded to size or cut from a molded sheet, 50 to 70 Shore A durometer according to ASTM D2240, minimum tensile strength 2250 psi (15.5 MPa) per ASTM D412.
   2. Random-Oriented, Fiber-Reinforced Elastomeric Pads: Preformed, randomly oriented synthetic fibers set in elastomer. Surface hardness of 70 to 90 Shore A durometer according to ASTM D2240. Capable of supporting a compressive stress of 3000 psi (20.7 Mpa) with no cracking, splitting or delaminating in the internal portions of the pad.
   3. Cotton-Duck-Fabric-Reinforced Elastomeric Pads: Preformed, horizontally layered cotton-duck fabric bonded to an elastomer. Surface hardness of 80 to 100 Shore A durometer according to ASTM D2240. Conforming to Division II, Section 18.10.2 of AASHTO LRFD Bridge Design Specifications or Military Specification, MIL-C-882E.
   4. Frictionless Pads: Polytetrafluoroethylene (PTFE), glass-fiber reinforced, bonded to stainless or mild-steel plates, or random-oriented, fiber-reinforced elastomeric pads, of type required for in-service stress.

B. Reglets: Stainless steel, Type 304.

C. Erection Accessories: Provide clips, hangers, high density plastic or steel shims, and other accessories required to install structural precast concrete members.

D. Welding Electrodes: Comply with AWS standards for steel type and/or alloy being welded.

E. Stair Tread Nosing: Wooster, Type 231BF, Black Stair Nosing.

F. Dove Tail Anchors.

G. Double Tee Stem Blockouts - Radius. High Concrete Accessories or equal.

2.08 GROUT MATERIALS

A. Sand-Cement Grout: Portland cement, ASTM C150/C150M, Type I, and clean, natural sand, ASTM C144, or ASTM C404. Mix at ratio of 1 part cement to 2 ½ to 3 parts sand, by volume, with minimum water required for placement and hydration. Water-soluble chloride ion content of grout less than 0.06 percent chloride ion by weight of cement when tested in accordance with ASTM C1218/C1218M.

B. Non-shrink Grout: Premixed, prepackaged ferrous and non-ferrous aggregate shrink-resistant grout containing selected silica sands, portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C1107/C1107M, Grade A for dry-pack and Grades B and C for flowable grout and of consistency suitable for application with a 30-minute working time. Water-soluble chloride ion content of grout less than 0.06 percent chloride ion by weight of cement when tested in accordance with ASTM C1218/C1218M.

C. Epoxy-resin grout: Two-component mineral-filled epoxy-resin: ASTM C881/C881M of type, grade, and class to suit requirements.

2.09 CONCRETE MIXTURES

A. Prepare design mixtures for each type of precast concrete required.
   1. Limit use of fly ash to 35 percent replacement of portland cement by weight; granulated blast-furnace slag to 50 percent of portland cement by weight; and metakaolin and silica fume to 10 percent of portland cement by weight.

B. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast plant personnel at structural precast concrete fabricator's option.

C. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 318 (ACI 318M) or PCI MNL 116 when tested in accordance with ASTM C1218/C1218M.

D. Normal Weight Concrete Mixtures: Proportion mixtures by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal weight concrete with the following properties:
   1. Compressive Strength (28 Days): 6,000 psi minimum, as required by design.
   2. Release Strength: as required by design.
   3. Maximum Water-Cementitious Materials Ratio: 0.36.

E. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL-116.

F. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.

G. Concrete Mixture Adjustments: Concrete mixture design adjustments may be proposed if characteristics of materials, Project conditions, weather, test results, or other circumstances warrant.

2.10 FORM FABRICATION

A. Form: Accurately construct forms, mortar tight, of sufficient strength to withstand pressures due to concrete placement and vibration operations and temperature changes, and for prestressing and de-tensioning operations. Coat contact surfaces of forms with release agent before reinforcement is placed. Avoid contamination of reinforcement and pre-stressing tendons by release agent.

B. Maintain forms to provide completed structural precast concrete members of shapes, lines, and dimensions indicated in Contract Documents, within fabrication tolerances specified.
   1. Edge and Corner Treatment: Uniformly chamfered or as built-in on standard forms.

2.11 FABRICATION

A. Cast all wall panels with architectural finish face down.

B. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware and secure in place during pre-casting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement. Do not relocate bearing plates in members unless approved by Architect.
   1. Weld headed studs and deformed bar anchors used for anchorage according to AWS D1.1/D1.1M and AWS C5.4, "Recommended Practices for Stud Welding."

C. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, hangers, and other hardware shapes for securing precast concrete members to supporting and adjacent construction.

D. Cast-in reglets, slots, and other accessories in structural precast concrete members as indicated on Contract Drawings.

E. Cast-in openings larger than 8 inches in any dimension. Do not drill or cut openings or pre-stressing strand without Engineer's approval.

F. Reinforcement: Comply with recommendations in PCI MNL 116 for fabricating, placing, and supporting reinforcement.
   1. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond with concrete. When damage to epoxy coated reinforcing exceeds limits specified in ASTM A775/A775M, repair with patching material compatible with coating material and epoxy coat bar ends after cutting.
   2. Accurately position, support, and secure reinforcement against displacement during concrete-placement and consolidation operations. Locate and support reinforcement by plastic tipped or corrosion resistant metal or plastic chairs, runners, bolsters, spacers, hangers, and other devices

for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 116.

3. Place reinforcing steel and pre-stressing tendons to maintain at least ¾ in. (19 mm) minimum concrete cover. Provide cover requirements in accordance with ACI 318 (ACI 318M) when units are exposed to corrosive environment or severe exposure conditions. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.
4. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces in accordance with ACI 318 (ACI 318M) and wire tie laps, where required by design. Offset laps of adjoining widths to prevent continuous laps in either direction.

G. Reinforce structural precast concrete members to resist handling, transportation, and erection stresses, and specified in-place loads, whichever governs.

H. Pre-stress tendons for structural precast concrete members by either pre-tensioning or post-tensioning methods. Comply with PCI MNL 116.
1. De-tension pre-tensioned tendons either by gradually releasing tensioning jacks or by heat-cutting tendons, using a sequence and pattern to prevent shock or unbalanced loading.
2. If concrete has been heat cured, de-tension while concrete is still warm and moist to avoid dimensional changes that may cause cracking or undesirable stresses.
3. Recess strand ends and anchorages exposed to view a minimum of 1 inch (25 mm), fill with non-metallic, non-shrink mortar and sack rub surface. Coat or spray the inside pocket surfaces with a bonding agent before installing mortar.
4. Protect strand ends and anchorage not exposed to view with bitumastic, zinc-rich or epoxy paint.

I. Comply with requirements in PCI MNL 116 and in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.

J. Place concrete in a continuous operation to prevent cold joints or planes of weakness from forming in precast concrete members.
1. Place backup concrete to ensure bond with face-mixture concrete.

K. Place face mixture to a minimum thickness after consolidation of the greater of 1 inch (25 mm) or 1.5 times the nominal maximum aggregate size, but not less than the minimum reinforcing cover as indicated on Contract Drawings.
1. Use a single design mixture for those members in which more than one major face (edge) is exposed.
2. Where only one face of unit is exposed and at the fabricator's option either of the following mixture design/casting techniques may be used:
    a. A single design mixture throughout the entire thickness of member.
    b. Design mixtures for facing and backup; using cement and aggregates for each type as appropriate, for consecutive placement in the form. Use cement and aggregate specified for facing mixture. Use cement and aggregate for backup mixture complying with specified criteria or as selected by the fabricator.

L. Thoroughly consolidate placed concrete by vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing or entrapped air voids on surfaces. Use equipment and procedures complying with PCI MNL 116.
1. Place self-consolidating concrete without vibration in accordance with PCI TR-6 "Interim Guidelines for the Use of Self-Consolidating Concrete." If face and backup concrete is used, ensure adequate bond between concrete mixtures.

M. Comply with PCI MNL 116 procedures for hot and cold-weather concrete placement.

N. Identify pickup points of precast concrete members and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each precast concrete member on a surface that will not show in finished structure.

O. Cure concrete, according to requirements in PCI MNL 116, by moisture retention without heat or by accelerated heat curing using live steam or radiant heat and moisture. Cure members until

compressive strength is high enough to ensure that stripping does not have an effect on the performance or appearance of final product.

2.12 FABRICATION TOLERANCES

A. Fabricate structural precast concrete members of shapes, lines and dimensions indicated, so each finished member complies with PCI MNL-135 product tolerances as well as position tolerances for cast-in items. Structural components to comply with PCI Tolerance Manual for Precast and Prestressed Concrete Construction PCI MNL-135.

B. Solid or insulated flat, structural wall panels with Architectural finishes to comply with PCI Tolerance Manual for Precast and Prestressed Concrete Construction PCI MNL-116 with the following exceptions:
   1. Length [a]
      a. Walls under 10' = (+/-) 1/8"
      b. Walls over 10' = (+/-) 1/4"
   2. Width [b] overall (+/-) 1/8"
   3. Local smoothness of any surface [h] = (+/-) 1/8" in 10'
   4. Differential bowing between adjacent panels of the same design [i1] = (+/-) 1/4"

2.13 FINISHES

A. Commercial (Structural) Finishes
   1. Commercial Grade: For precast not exposed to view. Remove fins and protrusions larger than 1/8 inch (3 mm) and fill holes with a diameter larger than ½ inch (13 mm). Rub or grind ragged edges. Faces shall be true, well-defined surfaces. Air holes, water marks, and color variations are acceptable. Allowable form joint offsets are limited to 3/16 in. (5mm).
   2. Grade B Finish: For beams, columns and tees. Fill air pockets and holes larger than 1/4 inch (6 mm) in diameter with sand-cement paste matching color of adjacent surfaces. Fill air holes greater than 1/8 inch (3 mm) in width that occur in high concentration (more than one per 2 in.^{2} [1300 mm^2]). Grind smooth form offsets or fins larger than 1/8 inch (3 mm). Repair surface blemishes due to dents in forms. Discoloration is permitted at form joints.

B. Smooth steel-trowel finish to all precast surfaces exposed to view in the exposed stairs, mechanical rooms, electrical rooms, laundry room and pool equipment room walls. Consolidate concrete, bring to proper level with straightedge, float and trowel to a smooth, uniform finish to mimic a smooth form finish.

C. Light broom finish to all precast surfaces exposed to view in the tennis facility.

D. Apply roughened surface finish in accordance with ACI 318 (ACI 318M) to precast concrete members that will receive concrete topping after installation.

E. Thin Brick Units: Thickness, not less than ½ in. (12.7 mm), nor more than 1 in. (25.4 mm) thick, with an overall tolerance of plus 0 in, minus 1/16 in. (+0 mm, -1.59 mm) for any unit dimension 8 in. (203.2 mm) or less and an overall tolerance of plus 0 in., minus 3/32 in. (+0 mm, -2.38 mm) for any unit dimension greater than 8 in. (203.2 mm) measured according to ASTM C67/C67M. Must comply with PCI Specifications for Embedded Clay Thin Brick.
   1. Face Size Utility, 3 5/8 in. (92.08 mm) high by 11 5/8 in. (295.28 mm) long.
      a. Metro Brick Company:
         1) TBR-1: Parkway – 107, Utility size, 1/3 running bond
         2) TBR-2: Brownstone – 108, Utility size, 1/3 running bond
   2. Special Shapes: Include corners, edge corners, and end edge corners.

F. Sand-blast architectural finish
   1. CC-3 with light sandblast as approved by architect after review of samples provided by precaster.

G. Colored Concrete:
   1. CC-1: To match TBR-1. Provide samples for Architect's approval
      a. White cement, colored admixture to achieve color match with approved samples provided by Architect. To be used at locations of TBR-1 and TBR-2.

2. CC-2: To match TBR-2. Provide samples for Architect's approval
    a. White cement, colored ad mixture to achieve color match with approved samples provided by Architect. To be used at locations of TBR-3.
3. CC-3: To match Senergy #361 Champagne Sahara/Medium Base. Provide samples for Architect's approval
    a. White cement, colored admixture to achieve color match with approved samples provided by Architect.

2.14 INSULATED FLAT WALL PANEL ACCESSORIES

A. Extruded-Polystyrene Board Insulation: ASTM C578, Type VI, 1.80 lb/cu. ft. (29 kg/cu. m); square edges; with R-value of 15 and thickness of 3". Stagger and tape all joints.

B. Wythe Connectors: Steel Wythe connectors manufactured to connect wythes of insulated precast concrete panels.
1. P-37 "M" Anchor shear connector by Dayton Superior.
2. Or approved equal.

2.15 FORM FABRICATION

A. Form: Accurately construct forms, mortar tight, of sufficient strength to withstand pressures due to concrete placement and vibration operations and temperature changes, and for pre-stressing and de-tensioning operations. Coat contact surfaces of forms with release agent before reinforcement is placed. Avoid contamination of reinforcement and pre-stressing tendons by release agent.

B. Maintain forms to provide completed structural precast concrete members of shapes, lines, and dimensions indicated in Contract Documents, within fabrication tolerances specified.
1. Edge and Corner Treatment of all exposed interior panel surfaces: Uniformly chamfered or as built-in on standard forms.
    a. Location: All walls with exposed concrete finishes. ie. stair shafts, mechanical / electrical rooms, pool equipment rooms, etc..

2.16 SOURCE QUALITY CONTROL

A. Quality-Control Testing: Test and inspect precast concrete according to PCI MNL 116 requirements. If using self-consolidating concrete also test and inspect according to PCI TR-6 "Interim Guidelines for the Use of Self-Consolidating Concrete" and ASTM C1611, ASTM C1712, ASTM C1610/C1610M, and ASTM C1621/C1621M.

B. Strength of precast concrete members will be considered deficient if units fail to comply with ACI 318 (ACI 318M) concrete strength requirements.

C. Testing: If there is evidence that strength of precast concrete members may be deficient or may not comply with ACI 318 (ACI 318M) requirements, fabricator shall employ an independent testing agency to obtain, prepare, and test cores drilled from hardened concrete to determine compressive strength according to ASTM C42/C42M and ACI 318/ACI 318M.
1. Test results shall be reported in writing on the same day that tests are performed, with copies to Architect, Contractor, and precast concrete fabricator. Test reports shall include the following:
    a. Project identification name and number.
    b. Date when tests were performed.
    c. Name of precast concrete fabricator.
    d. Name of concrete testing agency.
    e. Identification letter, name, and type of precast concrete member(s) represented by core tests; design compressive strength; type of failure; actual compressive strength at breaks, corrected for length-diameter ratio; and direction of applied load to core in relation to horizontal plane of concrete as placed.

D. Patching: If core test results are satisfactory and precast concrete members comply with requirements, clean and dampen core holes and solidly fill with precast concrete mixture that has no coarse aggregate, and finish to match adjacent precast concrete surfaces.

E. Acceptability. Structural precast concrete members that do not comply with acceptability requirements in PCI MNL 116, including concrete strength, and manufacturing tolerances, are unacceptable.

Chipped, spalled or cracked members may be repaired. Replace unacceptable units with precast concrete members that comply with requirements.

2.17 PRECAST CONCRETE STAIRS

A. Design stairs and components, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance of Stairs: Stairs shall withstand the effects of gravity loads including finishes and the following loads and stresses within limits and under conditions indicated.
   1. Uniform Live Load: 100 lbf/sq. ft. (4.79 kN/sq. m).
   2. Concentrated Live Load: 300 lbf (1.33 kN) applied on an area of 4 sq. in. (2580 sq. mm).
   3. Uniform and concentrated loads need not be assumed to act concurrently.
   4. Stair Reinforcement: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
   5. Limit deflection of treads, platforms, and framing members to L/240 or 1/4 inch (6.4 mm), whichever is less.

C. Dimensions of Stairs:
   1. See drawings for dimensions of stairs. Fabrication of stairs must comply with the tolerances required by code.

D. Cast-in Accessories:
   1. See Section 05 51 00 for railing.
      a. Provide steel sleeves for handrails.
      b. Sleeves shall be embedded and reinforced such that the structural requirements listed in section 05 51 00 are met.
   2. Provide Abrasive Aluminum Stair nosings:
      a. American Safety Tread, 801
      b. Or Equal.
   3. See details for more information.

E. Finishes of Precast stairs:
   1. See finish schedule. If no finish is specified, provide architectural finish as specified in this section.

PART 3 EXECUTION

3.01 PREPARATION

A. Furnish loose connection hardware and anchorage devices for precast concrete members to be embedded in or attached to the building structural frame or foundation before starting that Work. Provide locations, setting diagrams, templates and instructions for the proper installation of each anchorage device.

3.02 EXAMINATION

A. Verify site is free of obstructions and ready to receive the work.

B. Examine supporting structural frame or foundation and conditions for compliance with requirements for installation tolerances, bearing surface tolerances, and other conditions affecting precast concrete performance.

C. Proceed with precast concrete installation only after unsatisfactory conditions have been corrected.

D. Contractor shall notify precast concrete erector that supporting cast-in-place concrete foundation and building structural framing has attained minimum allowable design compressive strength or supporting steel or other structure is structurally ready to receive loads from precast concrete members prior to proceeding with installation.

E. Beginning the work of this section indicates acceptance of existing conditions.

3.03 THIN AND HALF BRICK FACINGS

A. Place form liner templates accurately to provide grid for brick facings. Provide solid backing and supports to maintain stability of liners while placing bricks and during concrete placement

B. Securely place brick units face down into form liner pockets and place concrete backing mixture.

C. Match appearance of sample units.

D. After stripping units, clean faces and joints of brick facing.

3.04 ERECTION

A. Install loose clips, hangers, bearing pads, and other accessories required for connecting structural precast concrete members to supporting members and backup materials.

B. Erect structural precast concrete level, plumb and square within the specified allowable erection tolerances. Provide temporary structural framing, shoring and bracing as required to maintain position, stability, and alignment of members until permanent connections are completed.
   1. Install temporary steel or plastic spacing shims or bearing pads as precast concrete members are being erected. Surface weld steel shims to each other to prevent shims from separating.
   2. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
   3. Remove projecting lifting devices and patch with sand-cement grout to fill voids within recessed lifting devices. Patch is to blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and patch, when viewed in typical daylight illumination from a distance of 20 feet.
   4. Unless otherwise indicated provide uniform joint widths of ½ in. (12.7 mm).

C. Connect structural precast concrete members in position by bolting, welding, grouting, or as otherwise indicated on approved Shop (Erection) Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and/or grouting are completed.
   1. Disruption of roof flashing continuity by connections is not permitted; concealment within roof insulation is acceptable.

D. Welding: Comply with applicable AWS D1.1/D1.1M, AWS D1.4/D1.4M and AWS D1.6/D1.6M requirements for welding, welding electrodes, appearance of welds, quality of welds, and methods used in correcting welding work.
   1. Protect structural precast concrete members and bearing pads from damage during field welding or cutting operations and provide noncombustible shields as required.
   2. Welds not specified shall be continuous fillet welds, using not less than the minimum fillet as specified by AWS D1.1/D1.1M, D1.4/D1.4M or D1.6/D1.6M.
   3. For galvanized metal, clean weld affected metal surfaces with chipping hammer followed by brushing or power tool cleaning, and apply a minimum 0.004 inch (4 mil) thick coat of galvanized repair paint to galvanized surfaces in conformance with ASTM A780/A780M.
   4. Visually inspect all welds critical to precast concrete connections. Visually check all welds for completion and remove re-weld or repair all defective welds.

E. At bolted connections, use upset threads, thread locking compound or other approved means to prevent loosening of nuts after final adjustment.
   1. Where slotted connections are used, verify bolt position and tightness at installation. For sliding connections, properly secure bolt but allow bolt to move within connection slot.
   2. For slip critical connections, one of the following methods shall be used to assure proper bolt pretension:
      a. Turn-of-Nut – in accordance with AISC.
      b. Calibrated Wrench – in accordance with AISC.
      c. Twist-off Tension Control Bolt – meeting ASTM F3125/F3125M.
      d. Direct-Tension Control Bolt – meeting ASTM F3125/F3125M.
   3. For slip critical connections, the method to be used and the inspection procedure to be used shall be approved by the Architect and coordinated with the inspection agency.

F. Grouting or Dry-Packing Connections and Joints: Indicate joints to be grouted and any critical grouting sequences on Shop (Erection) Drawings. Grout open spaces at keyways, connections and joints where required or indicated. Provide reinforcing steel where indicated. Retain flowable grout in place until it gains sufficient strength to support itself. Fill joints completely without seepage to other surfaces. Alternatively, pack spaces with stiff dry pack grout material, tamping until voids are completely filled. Place grout and finish smooth, level, and plumb with adjacent concrete surfaces.

Promptly remove grout material from exposed surfaces before it affects finishes or hardens. Keep grouted joints damp for at least 24 hours after initial set.

1. Trowel top of grout joints on roofs smooth to prevent any unevenness that might interfere with placing of, or cause damage, to insulation and roofing. Finish transitions due to different surface levels not steeper than 1 to 12.

G. Field cutting of precast, pre-stressed concrete members is not permitted without approval of the Engineer.

H. Fasteners: Do not use drilled or power-actuated fasteners for attaching accessory items to precast, pre-stressed concrete members unless approved by Precast Engineer and Engineer of Record.

I. It is the sole responsibility of the precast erector to ensure erection stability / safety at all times until the building is in its final condition. The precast erector shall create and submit to the General Contractor for record an erection plan addressing the erection sequence and the stability of the structure during construction. The plan shall include temporary connection such as shoring, guying, bracing, and specific erection sequence requirements. At a minimum the temporary structural system shall be capable of resisting a 10 psf (working load) lateral load in any direction applied to the projected area of such members/system under consideration. The erection plan shall be signed sealed and a registered engineer in the state of the project.

3.05 ERECTION TOLERANCES

A. Erect structural precast concrete members level, plumb, square, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 135. Level out variations between adjacent members by jacking, loading, or any other feasible method as recommended by the fabricator, UNO.

B. Solid or insulated flat structural wall panels with architectural finishes to comply with PCI Tolerance Manual for Precast and Prestressed Concrete Construction MNL 135-00, section 12.5 Architectural Walls / Spandrel erection Tolerances.

3.06 SEALANT INSTALLATION

A. General Contractor shall coordinate with the precast erector as required to seal precast joints.

B. Install backer rod and sealant according to product manufacturer's instructions.

C. See section 07 92 00.

3.07 FIELD QUALITY CONTROL

A. Special Inspections: Contractor will engage a qualified special inspector to perform the following special inspections and prepare reports:

1. Erection of load bearing precast concrete members.
2. Welding: size, configuration, detailing per approved drawings.
3. Bolted connections prior to grouting procedures.
4. Bearing pad placement
5. Grouting of specialty connection e.g. Lenton grout sleeves
6. Grouting procedures.

B. Testing: Contractor will engage accredited independent testing and inspecting agency to perform field tests and inspections and prepare reports.

1. Field welds will be subject to visual inspections and dye penetrate or magnetic particle testing in accordance with ASTM E165/E165M or ASTM E1444. Testing agency shall be qualified in accordance with ASTM E543.
2. Testing agency will report test results promptly and in writing to Contractor and Architect.

C. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.

D. Additional testing and inspecting, at Erector’s expense, will be performed to determine compliance of corrected work with specified requirements.

3.08 REPAIRS

A. Repairs will be permitted provided structural adequacy, serviceability and durability of members and appearance are not impaired.

B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 20 feet (6 m).Prepare and repair damaged galvanized coatings with galvanizing repair paint according to ASTM A780/A780M.

C. Wire brush, clean, and paint damaged prime-painted components with same type of shop primer.

D. Remove and replace damaged structural precast concrete members when repairs do not comply with specified requirements.

3.09 CLEANING

A. Clean mortar, plaster, fireproofing, weld slag, and any other deleterious material from concrete surfaces and adjacent materials immediately.

B. Clean exposed surfaces of precast concrete members after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.

C. Perform cleaning procedures, if necessary, according to precast concrete fabricator's recommendations. Protect adjacent work from staining or damage due to cleaning operations.

D. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

END OF SECTION

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SECTION 03 45 00
PRECAST ARCHITECTURAL CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Architectural precast concrete such as wall panels, sills, wall caps, column features, light sconce backing etc.

B. Supports, anchors, and attachments.

1.02 RELATED SECTIONS

A. Section 01 33 00 - Submittal Procedures.

B. Section 01 40 00 - Quality Requirements.

C. Section 01 45 33 - Code-Required Special Inspections and Procedures.

D. Section 01 60 00 - Product Requirements.

E. Section 03 20 00 - Concrete Reinforcement.

F. Section 03 30 00 - Cast in Place Concrete.

G. Section 03 45 70 - Architectural Site Cast Concrete Wall Panels.

H. Section 04 20 00 - Unit Masonry Assemblies.

I. Section 07 92 00 - Joint Sealants.

1.03 REFERENCE STANDARDS

A. ACI 301 American Concrete Institute; Specifications for Structural Concrete.

B. ACI 318 - Building Code Requirements for Structural Concrete; 2019 (Reapproved 2022).

C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

D. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

E. ASTM A370 - Standard Test Methods and Definitions for Mechanical Testing of Steel Products; 2021.

F. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2022.

G. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2023.

H. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.

I. ASTM C191 - Standard Test Methods for Time of Setting of Hydraulic Cement by Vicat Needle; 2021.

J. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete; 2010a (Reapproved 2016).

K. ASTM C330/C330M - Standard Specification for Lightweight Aggregates for Structural Concrete; 2023.

L. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2019, with Editorial Revision (2022).

M. ASTM C618 - Standard Specification for Coal Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2023, with Editorial Revision.

N. ASTM C881/C881M - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete; 2020a.

O. ASTM C939/C939M - Standard Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method); 2016.

P. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete; 2016.

Q. ASTM C989/C989M - Standard Specification for Slag Cement for Use in Concrete and Mortars; 2024.

R. ASTM C1059/C1059M - Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete; 2021.

S. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2020.

T. ASTM C1293 - Standard Test Method for Determination of Length Change of Concrete Due to Alkali-Silica Reaction; 2018.

U. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).

V. COE CRD-C 621 - Specification for Non-Shrink Grout; 1988.

W. PCI MNL-117 - Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products; 2013.

X. PCI MNL-120 - PCI Design Handbook; 2017, with Errata (2021).

1.04 FIELD SAMPLES

A. Provide architectural precast concrete for field sample construction as designed by Architect. Field sample to indicate proposed range of color, texture and workmanship expected in completed work.

1.05 MOCK-UPS

A. Provide architectural precast concrete for mock-up construction as designed by Architect.
   1. Mock-up to indicate proposed range of color, texture and workmanship expected in completed work.

B. Coordinate mock-up with Section 04 20 00 - Unit Masonry.

C. Obtain acceptance of visual qualities of mock-up prior to proceeding with work.

1.06 SYSTEM DESCRIPTION

A. Members to withstand own weight, design loads due to pressure and suction of wind, erection forces, and live and dead loads.

B. Component connections to accommodate building movement. Provide adjustment to accommodate misalignment of structure without permanent distortion, damage to components, wracking of joint connection, breakage of seals, or moisture penetration.

1.07 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Design members under direct supervision of Professional Engineer experienced in design of precast concrete units.

C. Conform to requirements of PCI MNL-120 Manual for Structural Design of Architectural Precast Concrete and to ACI 318.

D. Precast Manufacturer and Erectors: Qualified in accordance with PCI MNL-117.

E. Welding: AWS D1.1/D1.1M.

F. Manufacture, Transportation, and Installation: Company specializing in providing architectural precast products and services normally associated with precast concrete construction with high quality architectural finishes.

1.08 SUBMITTALS

A. Material and Equipment Submittals: Submit the following under provisions of Section 01 33 00-Submittals:
   1. Shop Drawings: Including the following:
      a. Unit dimensions.
      b. Finishes.
      c. Reinforcement and connection details.
      d. Unit installation locations and identification marks.

e. Fabrication details.
f. Relationship to adjacent materials.
g. Erection drawings.

2. Manufacturer's Installation Instructions: Include surface cleaning instructions.
3. Samples: Submit two (2) 12" x 12" samples for approval of workmanship, finish and color. Each sample to show joint between pieces.
4. Mix Design: Indicate proposed mix design of each class of concrete to Architect/Engineer review 15 days prior to commencement of work. Do not begin concrete production until mixes have been reviewed and accepted by Architect/Engineer.
   a. Submit proposed mix design for each class of concrete specified, at least 14 days prior to placing the concrete. Include proportions of ingredients, aggregate analysis, cement brand and type, slump, water/cement ratio, and strength test reports for 7 and 28 day strengths.

B. Procurement:
1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
2. Submit inventory to Owner within 5 days of delivery of materials.
3. See Sections 01 33 00 and 01 60 00.

C. Perform and submit reports of Code Required Special Inspections as required in Section 01 45 33.

1.09 PRE-INSTALLATION CONFERENCE

A. Convene a pre-installation conference under provisions of Section 01 31 00 Project Management and Coordination one week prior to commencing work of this Section.
1. Require attendance of Contractor, precast installer, and parties' directly affecting work of this Section.
2. Review conditions of installation, installation procedures and coordination required with Related Work.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Transport, handle, store, and protect under provisions of Section 01 60 00 - Materials and Equipment.

B. Handle precast members to position, consistent with their shape and design. Lift and support only from support points.

C. Lifting or Handling Equipment: Capable of maintaining units during manufacture, storage, transportation, erection, and in position for fastening.

D. Blocking and Lateral Support during Transport and Storage: Clean, non-staining, without causing harm to exposed surfaces. Provide temporary lateral support to prevent bowing and warping.

E. Protect edges of members to prevent staining, chipping, or spalling of concrete.

F. Mark units with date of production and final position in structure, in location not visible to exterior view.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Prior Approved Manufacturer, Certified by the Cast Stone Institute.

2.02 CONCRETE MATERIALS

A. Cement: ASTM C150/C150M, Portland Type I or Type III - normal white. All cement shall be from the same source throughout out project.

B. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
1. Portland Cement: ASTM C150.
2. Fly Ash: ASTM C618, Class C or F.
3. Ground Granulated Blast-Furnace Slag: ASTM C989/C989M, Grade 100 or 120.

C. Fine and Coarse Aggregate: ASTM C33/C33M and ASTM C330/C330M.

D. Water: Drinkable.

E. Reinforcing Steel: ASTM A615/A615M deformed steel bars, galvanized finish; strength and size commensurate with precast unit design.

2.03 ADMIXTURES

A. Prohibited Admixtures: Calcium chloride thiocyanates or admixtures containing more than 0.05 percent chloride ions are not permitted.

B. Air Entraining Admixture:
   1. Air entraining admixture shall comply with ASTM C260/C260M, and be certified by the manufacturer to be compatible with other admixtures to be used. Acceptable manufacturers and products:
      a. Euclid Chemical Company - Air Mix or AEA-92 Series.
      b. Grace Construction Products - Darex or Daravair series.
      c. BASF - MB-VR or MB-AE.

C. Water-Reducing Admixture:
   1. Manufacturers:
      a. Euclid Chemical Company, Eucon Series.
      b. BASF, Pozzolith Series.
      c. WR Grace, WRDA Hycol.
   2. Conform to ASTM C494/C494M, Type A.
   3. Compatible with other admixtures in the same mix design.

D. Water-Reducing, Retarding Admixture:
   1. Manufacturers:
      a. Euclid Chemical Company, Eucon Retarder - 75 or Eucon DS.
      b. BASF, Pozzolith 100XR.
      c. WR Grace, Daratard Series.
   2. Conform to ASTM C494/C494M, Type D and not more than 0.05 percent chloride ions.
   3. Compatible with other admixtures in the same mix design.

E. High-Range Water-Reducing Admixture:
   1. Manufacturers:
      a. Euclid Chemical Company, Eucon 37, 537 or Plastol Series.
      b. BASF, Rheobuild 1000 or Glenium Series.
      c. WR Grace, Daracem or Adva series.
   2. Conform to ASTM C494/C494M, Type F or Type G and containing not more than 0.05 percent chloride ions.
   3. Compatible with other admixtures in the same mix design.

F. Viscosity Modifying Admixture (VMA): Liquid admixture used to optimize viscosity of Self-Consolidating Concrete (SCC). Products: Subject to compliance with requirements, provide the following at dosage rates per manufacturer's recommendation:
   1. "Visctrol", The Euclid Chemical Company.
   2. "Boral SL", Boral Material Technologies.
   3. "Rheomac VMA Series", Master Builders.

G. Non-corrosive, Non-chloride Accelerator: The admixture shall conform to ASTM C494/C494M, Type C or E, and not contain more chloride ions than are present in municipal drinking water. The admixture manufacturer must have long-term non-corrosive test data from an independent testing laboratory (of at least a year's duration) using an acceptable accelerated corrosion test method such as that using electrical potential measures.
   1. Manufacturers:
      a. Euclid Chemical Company, Accelguard 80/90 or NCA.
      b. Conform to ASTM C494/C494M, Type C or E.
      c. Compatible with other admixtures in the same mix design.

H. Alkali-Silica Reactivity Inhibitor: A specially formulated lithium nitrate admixture for the prevention of alkali-silica reactivity (ASR) in concrete. The admixture must have test data indicating conformance to ASTM C1293, “Standard Test Method for Concrete Aggregates by Determination of Length Change of Concrete Due to Alkali-Silica Reaction”.
   1. Manufacturers:
      a. “Eucon Integral ARC” by Euclid Chemical Co.

I. Color Pigment: ASTM C979/C979M, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, non-fading, and resistant to lime and other alkalis.
   1. Manufacturers:
      a. Davis Colors.
      b. Solomon Colors.
      c. Increte/Euclid Chemical.
   2. Color: As selected by Architect from manufacturer's full range.

J. Certification: Written conformance to the above-mentioned requirements and the chloride ion content of admixtures will be required from the admixture manufacturer prior to mix design review by the Engineer.

2.04 GROUT MATERIALS

A. Non-shrink Grout: Conforming to ASTM C1107/C1107M "Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-Shrink). Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 7000 psi in 28 days;
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. "Masterflow 713", BASF
      b. "Euco-NS', Euclid Chemical Co;
      c. "Five Star Grout," U.S. Grout Co;

B. Non-Shrink Grout for Pre-Cast: Non-shrink, non-staining, high strength grout, conforming to ASTM C1107/C1107M “Standard Specification for Packaged Dry Hydraulic-Cement Grout, and providing extended working time for setting pre-cast concrete members; providing an initial setting time of 50 minutes per ASTM C191, providing positive expansion of .06% at 28 days, and capable of developing minimum compressive strengths of 5000 psi at 1 day and 12,000 psi at 28 days.
   1. Products: Subject to compliance with requirements, provide the following or approved equal:
      a. Euco Pre-cast Grout.

C. Cable Grout: Extremely flowable, pumpable, non-shrink, high-strength grout providing corrosion protection for steel cables, anchorages, and rods; providing a minimum flow rate of 15 to 25 seconds per ASTM C939/C939M and COE CRD-C 621; capable of developing minimum compressive strengths of 3000 psi at 1 day and 10000 psi at 28 days.
   1. Products: Subject to compliance with requirements, provide the following:
      a. Euco Cable Grout.

2.05 REPAIR MATERIALS

A. Epoxy Adhesive: ASTM C881/C881M, 2-component, 100% solids, epoxy resin, of type, grade and class to suit requirements.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Dural Series by The Euclid Chemical Co
      b. Sikadur Series by Sika Corp.

B. Bonding Agent: ASTM C1059/C1059M, Type II, non-re-dispersible, acrylic emulsion or styrene butadiene.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. “Flexcon” or “Akkro 7T”; Euclid Chemical Company.
      b. “Daraweld”; WR Grace.
      c. “Sika Latex”; Sika Corp.

C. Pre-Packaged Repair Mortar: Fast-setting, Portland cement based, repair mortar, capable of achieving a minimum 6,100 psi compressive strength in 28 days.
   1. Products: Subject to compliance with requirements, provide one of the following or approved equal:
      a. Speedcrete Redline by The Euclid Chemical Co.

2.06 SUPPORT DEVICES

A. Connecting and Support Devices: ASTM A36/A36M weldable steel.

B. Bolts, Nuts, and Washers: ASTM A370; high strength steel.

C. Anchors and Dowels:
   1. All anchors, dowels and other anchoring devices and shims shall be standard building stone anchors commercially available in a non-corrosive material such as zinc plated, galvanized steel, brass, epoxy or stainless steel Type 302 or 304.

2.07 PROPORTIONING AND DESIGN OF CONCRETE MIXES

A. Prepare design mixes for each type of concrete required. All mix designs shall be proportioned in accordance with Section 5.3, "Proportioning on the Basis of Field Experience and/or Trial Mixtures" of ACI 318-05. Submit mix designs on each class of concrete for. If field experience based mixes are submitted, all materials shall be from the same sources and with the same brand names as the previously utilized mix. If trial batches are used, the mix design shall be prepared by an independent testing laboratory and shall achieve an average compressive strength 1,200 psi higher than the specified strength. This over-design shall be increased to 1,400 psi when concrete strengths of 5,000 or more are used. The proposed mix designs shall be accompanied by complete standard deviation analysis or trial mixture test data. The testing facility shall not be the same as used for field quality control testing.
   1. Limit use of fly ash to not exceed 25 percent of cementitious content by weight.
   2. Limit use of slag to not exceed 40 percent of cementitious content by weight.
   3. The exact percentages used shall be based on a successful test placement on-site.

B. Design mixes may be prepared by a qualified independent testing agency or by qualified precast plant personnel at precast structural concrete fabricator's option.

C. Limit water-soluble chloride ions to .05%

D. Normal-Weight Concrete: materials to be used on Project, to provide normal-weight concrete with the following properties:
   1. Compressive Strength: 5000 psi at 28 days.

E. Self-consolidating concrete may be used for all architectural concrete and heavily reinforced members where noted on the plans, when approved by the architect/engineer. The concrete shall contain the specified high range water reducing admixture and viscosity modifying admixture as required. Slump flow shall be 20” to 30”. A successful placement onsite is required to verify proper workability, pumpability, setting time, and finish.

F. Admixtures:
   1. Use water-reducing admixture or high range water-reducing admixture (superplasticizer) in all concrete as required for placement and workability.
   2. Accelerating: Use the specified non-corrosive accelerator in all concrete, less than 8 inches in thickness, placed at air temperature below 50 degrees Fahrenheit.
   3. Use high-range water-reducing admixture in pumped concrete, concrete for industrial slabs, architectural concrete, parking structure slabs, concrete required to be watertight, self-consolidating concrete, concrete with ultimate strength of 5,000 psi or more, and concrete with water/cement ratios below 0.50.
   4. All concrete exposed to freezing and thawing and/or required to be watertight shall have an air content of 4.5% to 7.5%. All interior, slabs subject to vehicular abrasion, shall have a maximum air content of 3%.

G. Concrete Mix Adjustments: Concrete mix design adjustments may be proposed if characteristics of materials, Project conditions, weather, test results or other circumstances warrant, at no additional cost to Owner and as accepted by Architect. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Architect before using in work.

2.08 JOINT SEALING

A. Provide non-sag, non-staining, urethane joint sealant (SLNT-1) at perimeter and intermediate joints in accordance with Section 07 92 00 - Joint Sealants.

2.09 FABRICATION

A. Maintain plant records and quality control program during production of precast units. Make records and access to plant available to Architect upon request.

B. Use rigid molds, constructed to maintain precast unit uniform in shape, size, and finish.

C. Maintain consistent quality during manufacture.

D. Embed reinforcing steel, anchors, inserts, plates, angles, and other cast-in items as indicated on shop drawings.

E. Fabricate connecting devices, plates, angles, inserts, bolts, and accessories. Fabricate to permit initial placement and final attachment.

F. Locate hoisting devices to permit removal after erection.

G. Cure units to develop concrete quality, and to minimize appearance blemishes such as non-uniformity, staining, or surface cracking.

H. Minor patching in plant acceptable, providing structural performance and appearance of units is not impaired.

I. Identify each precast unit with corresponding code on erection drawings, in location not visible in finish work.

2.10 FINISH - PRECAST UNITS

A. Ensure exposed-to-view finish surfaces of precast units are uniform in color and appearance.

B. Architectural Concrete Finish: Provide smooth, uniform finish upon form removal with no patching, stoning, or other form of repair, except washing, permitted unless otherwise noted, for walls, columns, and other surfaces visible to view when the work is complete. Use Self Consolidating Concrete. The surface shall match the approved jobsite mockup panel.

C. Color: Submit samples from manufacturer’s full range of colors for architect’s approval.

D. Texture: Light acid etch.

2.11 FINISH - SUPPORT DEVICES

A. Clean surfaces of rust, scale, grease and foreign matter.

B. Prime paint non-exposed connectors in two coats, except surfaces in direct contact with concrete or requiring field welding.

C. Galvanize exposed connectors after fabrication to 2.0 oz/sq ft in accordance with ASTM A123/A123M.

PART 3 EXECUTION

3.01 INSPECTION

A. Verify building structure, anchors, devices, and openings are ready to receive work of this Section.

B. Beginning of installation means acceptance of existing condition.

3.02 PREPARATION

A. Provide for erection procedures and induced loads during erection. Maintain temporary bracing in place until final support is provided.

B. Provide necessary hoisting equipment.

3.03 ERECTION

A. Erect units without damage to shape or finish. Replace or repair damaged panels.

B. Erect members level and plumb within allowable tolerances.

C. Align and maintain uniform horizontal and vertical joints as erection progresses.

D. When members require adjustment beyond design or tolerance criteria, discontinue affected work; advise Architect.

E. Fasten units in place. Perform welding, including tack welds, in accordance with AWS D1.1/D1.1M.

F. Touch-up field welds and scratched or damaged galvanized surfaces with cold process galvanizing coating in accordance with manufacturer's instructions.

G. Set vertical units dry, without grout, attaining joint dimension with lead or plastic spacers. Grout pack base of unit.

H. Seal perimeter and intermediate joints in accordance with Section 07 92 00 - Joint Sealants with SLNT-1.

I. Provide cotton rope weeps at each panel joint 6" above grade.

3.04 TOLERANCES

A. Offset from True Alignment Between Two Connecting Members: 1/8" maximum.

B. Out of Square: 1/8" in 10 feet maximum, non-cumulative.

C. Variation in Dimensions Indicated on Shop Drawings: Plus or minus 1/8".

D. Misalignment of Anchors, Inserts, Openings: 1/8" maximum.

E. Exposed Joint Dimension: 3/8" plus or minus 1/8".

3.05 PROTECTION

A. Protect members from damage.

B. Provide non-combustible shields during welding operations.

3.06 CLEANING

A. Clean all exposed surfaces after installation, in accordance with manufacturer's instructions. Use non-harmful, non-discoloring, and non-staining agents and devices. Protect adjacent areas from rundown.

B. Do not use metal cleaning tools and brushes or abrasive powders.

END OF SECTION

SECTION 04 2000
UNIT MASONRY

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Concrete masonry units (CMU's).
   2. Quarried Stone.
   3. Face brick.
   4. Joint reinforcement, anchorage and accessories.
   5. Installation of reinforcing bars in unit masonry.
   6. Installation of anchor bolts and other embedments in unit masonry.

1.02 RELATED SECTIONS

A. Section 01 31 00 - Project Management and Coordination.

B. Section 01 33 00 - Submittal Procedures.

C. Section 01 40 00 - Quality Requirements.

D. Section 01 45 33 - Code-Required Special Inspections and Procedures.

E. Section 01 60 00 - Product Requirements.

F. Section 03 20 00 - Concrete Reinforcement.

G. Section 03 30 00 - Cast in Place Concrete.

H. Section 03 45 00 - Precast Architectural Concrete.

I. Section 03 45 70 - Architectural Site Cast Concrete Wall Panels.

J. Section 07 27 26 - Fluid Applied Membrane Air Barriers.

K. Section 07 21 00 - Thermal Insulation.

L. Section 07 92 00 - Joint Sealants.

1.03 REFERENCE STANDARDS

A. ANSI A118.4 - American National Standard Specifications for Modified Dry-Set Cement Mortar; 2023.

B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.

D. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2022.

E. ASTM A951/A951M - Standard Specification for Steel Wire for Masonry Joint Reinforcement; 2022.

F. ASTM A996/A996M - Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement; 2016.

G. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2023, with Editorial Revision.

H. ASTM C55 - Standard Specification for Concrete Building Brick; 2023.

I. ASTM C67/C67M - Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile; 2023.

J. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units; 2023.

K. ASTM C91/C91M - Standard Specification for Masonry Cement; 2023.

L. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 50 mm [2 in.] Cube Specimens); 2023.

M. ASTM C140/C140M - Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units; 2023a.

N. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2018.

O. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.

P. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2018.

Q. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale); 2023.

R. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2019a, with Editorial Revision.

S. ASTM C404 - Standard Specification for Aggregates for Masonry Grout; 2024.

T. ASTM C476 - Standard Specification for Grout for Masonry; 2023.

U. ASTM C482 - Standard Test Method for Bond Strength of Ceramic Tile to Portland Cement Paste; 2020.

V. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2019, with Editorial Revision (2022).

W. ASTM C618 - Standard Specification for Coal Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2023, with Editorial Revision.

X. ASTM C652 - Standard Specification for Hollow Brick (Hollow Masonry Units Made from Clay or Shale); 2022.

Y. ASTM C780 - Standard Test Methods for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry; 2023.

Z. ASTM C1019 - Standard Test Method for Sampling and Testing Grout for Masonry; 2020.

AA. ASTM C1242 - Standard Guide for Selection, Design, and Installation of Dimension Stone Attachment Systems; 2022a.

BB. ASTM C1506 - Standard Test Method for Water Retention of Hydraulic Cement-Based Mortars and Plasters; Current Edition.

CC. ASTM D226/D226M - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing; 2017 (Reapproved 2023).

DD. ASTM D2287 - Standard Classification System and Basis for Specification for Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds; 2019.

EE. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.

FF. NCMA TEK 8-2A - REMOVAL OF STAINS FROM CONCRETE MASONRY; Current Edition.

GG. NCMA TEK 10-2D - CONTROL JOINTS FOR CONCRETE MASONRY WALLS—EMPIRICAL METHOD; Current Edition.

HH. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2022, with Errata (2024).

II. Brick Industry Association (BIA) Technical Notes on Brick Construction 2006.

1.04 SUBMITTALS

A. Reinforcement shop drawings (structural walls):
   1. Show all wall reinforcing on elevations. Show placement of reinforcing, bar sizes, splice lengths, cover and bending detail. Include wall control joint locations.

B. Coursing shop drawings (stone walls):
   1. Submit proposed coursing pattern for approval.

C. Concrete Masonry Units:
   1. Submit certification of type, density, shrinkage and shape of concrete masonry units for each size/shape used.

2. Submit material certificates for each size and type of product, including ASTM C90 certification and ASTM C140/C140M test data.
3. Show conformance to shape requirements.

D. Grout:
1. Mix Design for each type of grout used (proportions of ingredients).
2. Material certificates: Portland Cement (ASTM C150/C150M), Fly Ash (ASTM C618), Hydrated Lime (ASTM C207).
3. Gradation of aggregates (ASTM C404).
4. Test breaks or historical data.

E. Mortar:
1. Mix Designs for each type of Mortar used.
2. Material certificates: Portland Cement (ASTM C150/C150M), Hydrated Lime (ASTM C207).
3. Gradation of sand (ASTM C144).
4. Range of colors for Architect's selection.

F. Submit product data and certification of masonry products to include:
1. Rebar positioners.
2. Horizontal joint reinforcement.
3. Veneer anchors.
4. Adjustable wall ties.
5. Rigid anchors.
6. Dovetail ties.

G. Samples for Verification: For each type and color of exposed masonry unit and mortar.

H. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.
2. Include test reports, according to ASTM C1019, for grout mixes required to comply with compressive strength requirement.

I. Mock-up:
1. See requirements for Mock-up panel in drawings and in Quality Assurance below.

J. Procurement:
1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
2. Submit inventory to Owner within 5 days of delivery of materials.
3. See Sections 01 33 00 and 01 60 00.

K. Perform and submit reports of Code Required Special Inspections as required in Section 01 45 33.

1.05 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Submit documentation indicating compliance with requirements for specified compressive strength of masonry f'm in accordance with the following. Testing to be arranged by Contractor and performed by testing agency contracted by Owner:
1. Unit Strength Method:
a. Determine compressive strength of masonry, based on strength of unit and type of mortar and masonry grout specified using TMS 402/602, Table 2. The following articles must be met:
1) Units conform to ASTM C55 or ASTM C90 and are sampled and tested in accordance with ASTM C140/C140M.
2) Masonry grout to meet specified requirements.

3) Mortar strength test in accord with ASTM C270.

C. Masonry Standard: Comply with TMS 402/602 unless modified by requirements in the Contract Documents.

D. Masonry Installer shall be certified by the Mason Contractors Association of America (MCAA).

E. Mock-up Panels: Build sample panels to verify selections made under sample submittals and to demonstrate aesthetic effects. Comply with requirements in Division 1 Section 01 40 00 "Quality Requirements" for mockups.
   1. Refer to drawings for more information on mock-up panel.
   2. Build sample panels to include each type of exposed unit masonry construction: See drawings for panel size.
   3. Construct sample panel such that all portions of the assembly are exposed. Include back up wall, vapor barrier, insulation, brick ties, mortar, drainage material, vents, weeps, and opening (if any).
   4. Sample panel shall not be incorporated into completed work.

1.06 PROJECT CONDITIONS

A. Cold-Weather Requirements: Do not work in temperatures below 35 degrees F and between 35 degrees F and 45 degrees F only when proper provision are made to protect the work from freezing for at least 48 hours after laying. Use enclosures as required. Remove any work exposed to freezing. Remove any frost from masonry setting beds and dry surface before laying brick. Obtain Owner's approval for all heating ingredients. The contractor shall provide artificial heat to enclosures in work areas when temperatures fall below 45 degrees F approved by Owner in advance.

B. Hot-Weather Requirements (above 80 degrees F): Protect the masonry and mortar from direct sunlight and exposure to wind to avoid rapid evaporation of water in the mortar before during and after masonry construction.

C. Mix mortar using sufficient quantities of water to ensure good workability in accordance with BIA recommendations. Control batching procedures to ensure proper and consistent proportions by measuring materials by volume. Use calibrating containers for each of the constituents for all batches throughout the project. Do not use shovel measurements of sand. Use volumetric dispenser for color admixtures where used. Mix with mechanical mortar mixer only for at least 3 minutes, but not more than 15 minutes. Use only workable mortar. Limit retempering to the extent practical and only retemper mortar on the board or in the tub one time. Completely clean remaining mortar off boards or tubs before adding fresh mortar. Use mortar within 2 hours of initial mixing at temperatures over 80 degrees F and 2 ½ hours at temperatures between 50 degrees F and 74 degrees F.

PART 2 PRODUCTS

2.01 MASONRY UNITS, GENERAL

A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.

B. Fire-Resistance Ratings: Where indicated, provide units that comply with requirements for fire-resistance ratings indicated as determined by testing according to ASTM E119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

2.02 CONCRETE MASONRY UNITS

A. Shapes: Provide shapes indicated and for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
   1. Structural walls shall be comprised of double corner units, open end (‘A’ Shaped) units, or double open end (‘H’ shaped) units. Use of stretcher block in structural walls may be subject to rejection.
      a. Stretcher units shall not be used in structural walls.

B. Finish:
   1. Typical: Standard.
   2. Where indicated on Drawings: Split faced.

a. Color: to be selected by Architect.

C. CMUs: ASTM C90.
1. Interior, non-load bearing walls: Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1,900 psi.
2. Structural walls: Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2,800 psi.
3. Density Classification: Normal weight.

D. Integral Water Repellent: At all exterior walls, provide units made with liquid polymeric, integral water repellent admixture that does not reduce flexural bond strength where indicated.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
a. ACM Chemistries; RainBloc.
b. BASF Aktiengesellschaft; Rheopel Plus.
c. Grace Construction Products, W. R. Grace & Co. - Conn.; Dry-Block.
d. Or approved equal.

E. Integral water repellant admixture for CMU shall only be used in conjunction with integral water repellant admixture for mortar.

2.03 QUARRIED STONE

A. Quarried Stone:
1. Hedberg Brick and Stone: Landmark Castle.
a. Coursed Ashlar Pattern:
1) Joints: Standard 3/8" joint treatment.
2) Lengths: 8" - 48"
3) Height: 2 1/4", 5" and 7 3/4" standard heights, patterned coursing.
(a) See Drawings for coursing pattern.
b. Depth:
1) Full Veneer, depth from 3" to 5". See details.
2) Thin Veneer, 3/4" to 1 1/2". See details.
(a) Comply with ASTM C1242 requirements for adhered stone system without mechanical anchors for maximum stone weight and maximum individual stone panel size.
(b) Comply with TMS 402/602 size requirements for adhered stone veneer units for maximum thickness, maximum face dimension, maximum face area and maximum weight per square foot.
2. Mortar Color:
a. See below.

2.04 BRICK

A. General: Provide shapes indicated and as follows:
1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
2. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.

B. Face Brick: Facing brick complying with ASTM C652.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
a. Approved Manufactures:
1) Belden Brick Company:
(a) FBR-1 (Field Brick): No. 8530.
(b) FBR-2 (Accent Brick): Field Gray Velour.
b. Face Brick: ASTM C216:
1) Size: Utility, 3-5/8” by 3-5/8” x 11-5/8”.

2) Brick Pattern: Running Bond typ; Window Header Soldier course only. See elevations.
3) Concave joints.

c. Grade: SW.
d. Type: FBX.
e. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 3350 psi (23.10 MPa).
f. Initial Rate of Absorption: Less than 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested per ASTM C67/C67M.
g. Efflorescence: Provide brick that has been tested according to ASTM C67/C67M and is rated "not effloresced."
h. Surface Coating: Brick with colors or textures produced by application of coatings shall withstand 50 cycles of freezing and thawing per ASTM C67/C67M with no observable difference in the applied finish when viewed from 10 feet (3 m).
i. Size (Actual Dimensions): 3-5/8 inches (92 mm) wide by 3-5/8 inches (92 mm) high by 11-5/8 inches (295 mm) long.

2.05 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

B. Hydrated Lime: ASTM C207, Type S.

C. Masonry Cements are NOT acceptable.

D. Colored Cement Product: Packaged blend made from portland cement and hydrated lime and mortar pigments, all complying with specified requirements, and containing no other ingredients.
1. Products: Subject to compliance with requirements, provide the following:
a. Colored Portland Cement-Lime Mix:
1) Holcim; Rainbow Mortamix.
2) Lehigh Cement Company; Lehigh Custom Color Portland/Lime Cement.
3) Or approved equal.
b. Color: Submit full range of colors for Architect's Selection.

E. Aggregate for Mortar: ASTM C144.
1. For joints less than 1/4 inch (6 mm) thick, use aggregate graded with 100 percent passing the No. 16 (1.18-mm) sieve.
2. White-Mortar Aggregates: Natural white sand or crushed white stone.
3. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

F. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C494/C494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
a. Euclid Chemical Company (The); Accelguard 80.
b. Grace Construction Products, W. R. Grace & Co. - Conn.; Morset.
c. Sonneborn Products, BASF; MasterSet FP 20.

G. Water: Potable.

2.06 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A615/A615M or ASTM A996/A996M, Grade 60 (Grade 420).

B. Masonry Joint Reinforcement, General: ASTM A951/A951M.
1. Interior Walls: Hot-dip galvanized, carbon steel.
2. Exterior Walls: Hot-dip galvanized, carbon steel.
3. Wire Size for Side Rods: 9 gage.
4. Wire Size for Cross Rods: 9 gage.

5. Wire Size for Veneer Ties: 9 gage.
6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches (407 mm) o.c.
7. Provide in lengths of not less than 10 feet (3 m), with prefabricated corner and tee units.
8. Masonry Joint Reinforcement for Single-Wythe Masonry: Either ladder or truss type with single pair of side rods.

C. Masonry Joint Reinforcement for Single-Wythe Masonry: truss type with single pair of side rods.
1. Products: Subject to compliance with requirements. Provide one of the following: Single Wythe Joint Reinforcement: Truss type; hot dipped galvanized to comply with ASTM A153/A153M, Class B2 coating; 9 gage side rods and cross ties. Provide preformed corners and tees.
   a. Hohman and Barnard, Inc., Lox-All No. 125 Truss-Mesh.
   b. Dur O Wal, Inc., Dur O Wal Truss.
   c. Wire Products, Blok Trus AA600.
   d. Masonry Reinforcing Corporation of America, Series 300, Single Wythe Truss Type.
   e. Or approved equal.

D. Masonry Joint Reinforcement for Veneers Anchored with Seismic Masonry-Veneer Anchors: Single 9 gage, hot-dip galvanized, carbon-steel continuous wire.

2.07 TIES AND ANCHORS

A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated.
1. Steel Sheet, Galvanized after Fabrication: ASTM A1008/A1008M, Commercial Steel, with ASTM A153/A153M, Class B coating.
2. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

B. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but with at least 5/8 inch (16-mm) cover on outside face. Outer ends of wires are bent 90 degrees and extend parallel to face of veneer.

C. Adjustable “Mechanical” Anchors for Connecting to CMU: Provide anchors that allow vertical adjustment but resist tension and compression forces perpendicular to plane of wall.
1. Connector Section: Backplate fastened to CMU and extending through rigid insulation with hole for pintle attachment; formed from 12-gauge thick, galvanized after fabrication.
   a. Fastener: powder-actuated knurled shank 0.157” dia., 1” embedment, Hilti X-U or approved equal.
2. Pintles: 1/4" diameter 2 wire brite galvanized steel anchors hot dipped galvanized to comply with ASTM A153/A153M, Class B2 coating; size for 4” quarried stone and variable air space up to 6”.
   a. Hohman and Barnard, Inc.
   b. Wire Products.
   c. Dur O Wall, Inc.
   d. Masonry Reinforcing Corporation of America.
   e. Or approved equal.

D. Adjustable “Mechanical” Anchors for Connecting to Cold-Formed Steel Framing: Provide anchors that allow vertical adjustment but resist tension and compression forces perpendicular to plane of wall.
1. Connector Section: Backplate fastened through sheathing to cold-formed steel framing and extending through rigid insulation with hole for pintle attachment; formed from 12-gauge thick, galvanized after fabrication.
   a. Fastener: No. 10 self-drilling screw.
2. Pintles: 1/4" diameter 2 wire brite galvanized steel anchors hot dipped galvanized to comply with ASTM A153/A153M, Class B2 coating; size for 4” quarried stone and variable air space up to 6”.
   a. Hohman and Barnard, Inc.
   b. Wire Products.
   c. Dur O Wall, Inc.
   d. Masonry Reinforcing Corporation of America.
   e. Or approved equal.

2.08 EMBEDDED FLASHING MATERIALS

A. Flexible Flashing: Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.040 inch (1.02 mm).
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Carlisle Coatings & Waterproofing; CCW-705-TWF XLT Thru-Wall Flashing.
      b. Grace Construction Products, W. R. Grace & Co. - Conn.; Perm-A-Barrier Wall Flashing.
      c. Hohmann & Barnard, Inc.; Textroflash.
      d. Dayton Superior Corporation, Dur-O-Wal Division; Dur-O-Barrier Thru-Wall Flashing.
      e. Or approved equal.

B. Stainless Steel Base Flashings and Drip Edges: See section 07 62 00.

C. Solder and Sealants for Sheet Metal Flashings: As specified in Section 07 62 00 - Sheet Metal Flashing and Trim. Solder all flashing joints / end dams water tight see sheet metal section 07 62 00 for additional information.

D. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.09 MISCELLANEOUS MASONRY ACCESSORIES

A. Preformed Control-Joint Gaskets: Made from PVC, complying with ASTM D2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
   1. Control Joint Resilient Keys: Shall be a poly vinyl chloride section with a minimum Shore Durometer hardness of 80. Shear section is 5/8” thick with 5/16” thick flanges. Total width shall be not less than 2 3/8”.
      a. Hohmann & Barnard Inc.; VS series (PVC joint)
      b. Wire-Bond; PVC joint.
      c. Dur-O-Wal - Rapid Poly Joint (PVC) regular.
      d. AA Wire Products - Blok-tite.
      e. Or approved equal.

B. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D226/D226M, Type I (No. 15 asphalt felt).

C. Cellular Plastic Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch (3 mm) less than depth of outer wythe, in color selected from manufacturer's standard.
   1. Vent Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Heckmann Building Products Inc.; No. 85 Cell Vent.
      b. Hohmann & Barnard, Inc.; Quadro-Vent.
      c. Or approved equal.

D. Rope Weeps: 3/8” diameter 100% cotton rope wicks, including core.

E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Mortar Net USA, Ltd.; Mortar Net.
      b. Advanced Building Products Inc. MortarBreak.
      c. Or approved equal.
   2. Installation: Install products according to the sizes, vertical spacing, and locations as recommended by manufacturer.

3. Color to be selected by architect.

2.10 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.
   1. Do not use calcium chloride in mortar or grout.
   2. Use portland cement-lime mortar unless otherwise indicated.
   3. For exterior masonry, use portland cement-lime mortar.
   4. For reinforced masonry, use portland cement-lime mortar.
   5. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.
   6. Water-reducing admixture is allowed only when approved by the Architect and Structural Engineer of Record, and only when the following conditions are continuously met when grouting cores:
      a. Fog or wet block cores to saturated surface dry (SSD) condition prior to and during grouting.
      b. Wet Faceshells of grouted block during grout cure.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Polymer-Modified Mortar:
   1. One-component, polymer fiber reinforced veneer mortar, to meet or exceed ASTM C270 compressive strength requirements and IBC ASTM C482 Shear bond strength requirements, and ANSI A118.4 for adhered stone and tile.
   2. For use to adhere exterior thin masonry units as shown on drawings.
      a. Exposed joints shall use Cementitious Mortar above.
   3. Manufacturers and Products:
      a. Basis of Design: Laticrete MVIS Veneer Mortar.
      b. Or approved equal.
   4. Water: Potable.

D. Mortar for Unit Masonry: Comply with ASTM C270, Specification. Provide the following types of mortar for applications stated unless another type is indicated.
   1. For masonry below grade or in contact with earth, use Type M.
   2. For reinforced masonry, use Type M or S.
   3. For exterior, unreinforced, above-grade, use Type N.
   4. For interior non-load-bearing partitions, Type O may be used instead of Type N.
   5. For applications where another type is not indicated, use Type N.

E. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color.
   1. Mix to match adjacent masonry unit, provide color chart for architect approval. Match Architect's sample.
   2. Application: Use colored aggregate mortar for exposed mortar joints with the following units:
      a. Quarried Stone: Color, Ivory Buff to match Architect's sample.
      b. Face Brick: Assume (2) different colors. Architect to select colors from manufacturer's full range.

F. Grout for Unit Masonry: Comply with ASTM C476.
   1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in TMS 402/602 for dimensions of grout spaces and pour height.

2.11 MASONRY SEALER

A. Penetrating, breathable Siloxane Sealer/Densifier. Comply with EPA's AIM VOC requirement
   1. Manufacturers and Products:
      a. Prosoco, SureKlean.

b. W.R. Meadows, Intraguard.
c. Or approved equal.

2. Application:
   a. Apply at exposed limestone and cast stone surfaces at base of building, between grade and base flashing.

PART 3 EXECUTION

3.01 INSTALLATION, GENERAL

A. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.

B. Do not use over burned or oil or grease marked bricks. Do not use bricks with cracks or splits in any face or with chips extending more than 1/8” from edges or ¼” from corners. Do not lay bricks until they are at least 60 days old.

C. When installing masonry under hot or cold conditions, follow guidelines found in BIA technical notes #1.

3.02 TOLERANCES

A. Dimensions and Locations of Elements:
   1. For dimensions in cross section or elevation do not vary by more than plus 1/2 inch (12 mm) or minus 1/4 inch (6 mm).
   2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2 inch (12 mm).
   3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4 inch (6 mm) in a story height or 1/2 inch (12 mm) total.

B. Lines and Levels:
   1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2 inch (12 mm) maximum.
   2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.
   3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2 inch (12 mm) maximum.
   4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.
   5. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2 inch (12 mm) maximum.

C. Joints:
   1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm), with a maximum thickness limited to 1/2 inch (12 mm).
   2. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch (9 mm) or minus 1/4 inch (6 mm).
   3. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm).

3.03 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.

C. Bond Pattern for Quarried Stone: Lay stone in random pattern with continuous horizontal bed joints not to exceed 18” o.c. vertically. Bed joint to be continuous for a minimum of 6’-0” lengths.

D. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

E. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

F. Fill cores in hollow CMUs with grout 24 inches (600 mm) under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

G. Protect incomplete masonry wall whenever work is not being performed by installing well fastened water proof coverings. Protect flashing against penetration or damage.

3.04 MORTAR BEDDING AND JOINTING

A. Lay hollow CMUs as follows:
   1. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.

B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

E. Collar Joints: Solidly fill collar joints by parging face of first wythe that is laid and shoving units of other wythe into place.

F. Corners: Provide interlocking masonry unit bond in each wythe and course at corners unless otherwise indicated.

G. Intersecting and Abutting Walls: Unless vertical expansion or control joints are shown at juncture, bond walls together as follows:
   1. Provide continuity with masonry joint reinforcement by using prefabricated T-shaped units.

3.05 CAVITY WALLS

A. Bond wythes of cavity walls together using one of the following methods:
   1. Individual Metal Ties: Provide ties as shown installed in horizontal joints, but not less than one metal tie for 2.0 sq. ft. (0.19 sq. m) of wall area spaced not to exceed 16 inches (406 mm) o.c. horizontally and 16 inches (406 mm) o.c. vertically. Stagger ties in alternate courses. Provide additional ties within 12 inches (305 mm) of openings and space not more than 36 inches (915 mm) apart around perimeter of openings. At intersecting and abutting walls, provide ties at no more than 24 inches (610 mm) o.c. vertically.
   2. Masonry Joint Reinforcement: Installed in horizontal mortar joints.
      a. Where bed joints of both wythes align, use ladder-type reinforcement extending across both wythes.
      b. Where bed joints of wythes do not align, use adjustable (two-piece) type reinforcement.

B. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.

C. Apply air barrier to face of backup wythe to comply with Section 07 27 26.

D. Installing Cavity-Wall Insulation (where shown on drawings): Place small dabs of adhesive, spaced approximately 12 inches (300 mm) o.c. both ways, on inside face of insulation boards, or attach with plastic fasteners designed for this purpose. Fit courses of insulation between wall ties and other

confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as shown.

3.06 MASONRY JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch (16 mm) on exterior side of walls, 1/2 inch (13 mm) elsewhere. Lap reinforcement a minimum of 6 inches (150 mm).
   1. Space reinforcement not more than 16 inches (406 mm) o.c.
   2. Space reinforcement not more than 8 inches (203 mm) o.c. in foundation walls and parapet walls.
   3. Provide reinforcement not more than 8 inches (203 mm) above and below wall openings and extending 12 inches (305 mm) beyond openings.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

3.07 ANCHORING MASONRY VENEERS

A. Anchor masonry veneers to backup with masonry-veneer anchors to comply with the following requirements:
   1. Fasten screw-attached anchors through sheathing to wall framing and to concrete and masonry backup with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
   2. Embed tie sections in masonry joints. Provide not less than 2 inches (50 mm) of air space between back of masonry veneer and face of sheathing.
   3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
   4. Space anchors as indicated, but not more than 18 inches (406 mm) o.c. vertically and 16 inches (610 mm) o.c. horizontally with not less than 1 anchor for each 2.0 sq. ft. (0.33 sq. m) of wall area. Install additional anchors within 12 inches (305 mm) of openings and at intervals, not exceeding 36 inches (914 mm), around perimeter.

3.08 MASONRY CONTROL AND EXPANSION JOINTS

A. Install control joints where indicated on drawings.
   1. Where no joints are indicated, place joints every 20' OC on exterior walls, and every 25' OC in interior walls. Place joints according to NCMA TEK 10-2D.
      a. In areas exposed to view, coordinate joint location with Architect.

B. Joints to be 3/4" wide, unless detailed otherwise.

C. Install expansion joint material as specified above and as detailed on drawings.

D. Reinforce joints as recommended by NCMA standards.

3.09 FLASHING, WEEP HOLES, AND CAVITY DRAINAGE

A. General: Install embedded flashing and weep holes/vents in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.

B. Install flashing as follows unless otherwise indicated:
   1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Slope flashing to exterior to promote prompt drainage. May slope 1/8” across brick width. Integrate flashing with backup wall waterproofing/ air barrier. Lap back up wall water proofing over unturned legs of through wall flashing 4”. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
   2. At lintels and shelf angles, extend flashing a minimum of 6 inches (150 mm) into masonry at each end. At heads and sills, extend flashing 6 inches (150 mm) at ends and turn up not less than 2 inches (50 mm) to form end dams. Solder all joints / end dams water tight.

3. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch (13 mm) back from outside face of wall and adhere flexible flashing to top of metal drip edge.
4. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch (13 mm) back from outside face of wall and adhere flexible flashing to top of metal flashing termination.
5. Install flashing or drip edge in bed of sealant. See detail.

C. Install weep holes in head joints in exterior wythes of first course of masonry immediately above embedded flashing and at last head joint at top of cavity as follows:
1. Use specified weep/vent products to form weep holes.
2. Locate Cavity vents at top and bottom of masonry wall sections as shown on drawings.
3. Space weep holes 24 inches (600 mm) o.c. unless otherwise indicated.

D. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.

3.10 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

B. Testing Prior to Construction: One set of tests.

C. Testing Frequency: One set of tests for each 5000 sq. ft. (464 sq. m) of wall area or portion thereof.

D. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C140/C140M for compressive strength.

E. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C780, 2500 psi.

F. Mortar Test (Property Specification): For each mix provided, according to ASTM C780. Test mortar for mortar air content and compressive strength.

G. Grout Test (Compressive Strength): For each mix provided, according to ASTM C1019, 3,000 psi.

3.11 REPAIRING, POINTING, AND CLEANING

A. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

B. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
1. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes.
2. Protect surfaces from contact with cleaner.
3. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
4. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
5. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.
6. Clean from top to bottom in small sections.

3.12 MASONRY WASTE DISPOSAL

A. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
1. Do not dispose of masonry waste as fill within 18 inches of finished grade.

B. Excess Masonry Waste: Remove excess clean masonry waste as described above, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION

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SECTION 05 1200
STRUCTURAL STEEL FRAMING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Structural steel.
   2. Non-Shrink Grout.

1.02 RELATED SECTIONS

A. Section 01 31 00 - Project Management and Coordination.

B. Section 01 33 00 - Submittal Procedures.

C. Section 01 40 00 - Quality Requirements.

D. Section 01 45 33 - Code-Required Special Inspections and Procedures.

E. Section 01 60 00 - Product Requirements.

F. Section 03 20 00 - Concrete Reinforcement.

G. Section 03 30 00 - Cast in Place Concrete.

H. Section 03 40 70 - Architectural Site-Cast Concrete Wall Panels.

I. Section 04 20 00 - Unit Masonry Assemblies.

J. Section 05 12 19 - Buckling-Restrained Braces

K. Section 05 31 00 - Steel Decking.

L. Section 05 40 00 - Cold Formed Metal Framing.

M. Section 06 20 00 - Rough Carpentry.

N. Section 09 91 00 - Painting.

1.03 REFERENCE STANDARDS

A. AISC 303 - Code of Standard Practice for Steel Buildings and Bridges; 2022.

B. AISC 360 - Specification for Structural Steel Buildings; 2022, with Errata (2023).

C. ASTM A6/A6M - Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling; 2023.

D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

E. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.

F. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished; 2018.

G. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

H. ASTM A216/A216M - Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service; 2021.

I. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2023.

J. ASTM A563/A563M - Standard Specification for Carbon and Alloy Steel Nuts (Inch and Metric); 2021a.

K. ASTM A572/A572M - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel; 2021, with Editorial Revision.

L. ASTM A668/A668M - Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use; Current Edition.

M. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2020.

N. ASTM A992/A992M - Standard Specification for Structural Steel Shapes; 2022.

O. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2020.

P. ASTM E94/E94M - Standard Guide for Radiographic Examination Using Industrial Radiographic Film; 2017.

Q. ASTM E164 - Standard Practice for Contact Ultrasonic Testing of Weldments; 2019.

R. ASTM E165/E165M - Standard Practice for Liquid Penetrant Testing for General Industry; 2023.

S. ASTM E709 - Standard Guide for Magnetic Particle Testing; 2021.

T. ASTM F436/F436M - Standard Specification for Hardened Steel Washers Inch and Metric Dimensions; Current edition.

U. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength; 2020.

V. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2023.

W. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).

X. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.

Y. RCSC (HSBOLT) - Specification for Structural Joints Using High-Strength Bolts; Research Council on Structural Connections; 2020.

Z. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 2004.

AA. SSPC-SP 2 - Hand Tool Cleaning; 2024.

BB. SSPC-SP 3 - Power Tool Cleaning; 2024.

CC. SSPC-SP 6 - Commercial Blast Cleaning; 2007.

DD. SSPC-SP 10 - Near-White Metal Wet Abrasive Blast Cleaning; 2015.

1.04 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawing submittals must conform with coordinated BIM models. See Section 01 31 00.05.

C. Shop Drawings: Show fabrication of structural-steel components.
   1. Include details of cuts, connections, splices, headed studs, counts, camber, holes, and other pertinent data.
   2. Include embedment drawings.
   3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
   4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pre-tensioned and slip-critical high-strength bolted connections.
   5. Shop drawings indicating number of studs and placement along beams. Actual stud layout to be provided in deck shop drawings.
   6. For structural steel connections that are not explicitly detailed in the Drawings, the fabricator shall design the connections in accordance with AISC 360 using LRFD methods.
      a. Include structural design data (calculations) signed and sealed by qualified professional engineer, registered in the state of the project, responsible for their preparation.
      b. Calculation shall be organized, clear and concise and shall include table of contents and page numbers.

c. Calculations shall be submitted concurrently with shop/erection drawings and shall be signed and sealed at time of submission. Shop drawings submitted without corresponding calculations will not be reviewed by the engineer.
d. Shop Drawings received without corresponding calculations will not be reviewed by the Engineer.

7. Phasing diagram indicating scope of work for each phase of work.
8. Changes from Construction documents:
   a. Cloud and clearly identify all changes or deviations from the construction documents.

D. Qualification Data: For qualified installer, fabricator (including AISC Certification), professional engineer, testing agency.

E. Welding certificates.

F. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

G. Mill test reports for structural steel, including chemical and physical properties.

H. Product Test Reports: For the following:
1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
2. Direct-tension indicators.
3. Tension-control, high-strength bolt-nut-washer assemblies.
4. Shop primers.
5. Non-shrink grout.

I. Procurement:
1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
2. Submit inventory to Owner within 5 days of delivery of materials.
3. See Sections 01 33 00 and 01 60 00.

J. Perform and submit reports of Code Required Special Inspections as required in Section 01 45 33.

1.05 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU or is accredited by the IAS Fabricator Inspection Program for Structural Steel (Acceptance Criteria 172).

C. Installer Qualifications: Qualified installer who participates in AISC Quality Certification Program and is designated an AISC-Certified Erector, Category ACSE.

D. Welding Qualifications: Qualify procedures and personnel per AWS D1.1/D1.1M, "Structural Welding Code - Steel."
1. Welders and welding operators performing Work on bottom-flange, demand-critical welds shall pass supplemental welder qualification testing, as required by AWS D1.8. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.

E. Comply with applicable provisions of the following specifications and documents:
1. AISC 303.
2. AISC 360.
3. RCSC (HSBOLT) "Specification for Structural Joints Using High Strength Bolts."

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
   1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
   2. Clean and relubricate bolts and nuts that become dry or rusty before use.
   3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F3125/F3125M fasteners and for retesting fasteners after lubrication.

1.07 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' recommendations to ensure shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

PART 2 PRODUCTS

2.01 MATERIALS

A. W-Shapes: ASTM A992/A992M or ASTM A572/A572M, Grade 50 (345).

B. Channels, Angles, S, M HP, C and, MS Shapes: ASTM A36/A36M or ASTM A572/A572M, Grade 50 (345).

C. Plate and Bar: ASTM A36/A36M or ASTM A572, Grade 50.

D. Cold-Formed Hollow Structural Sections: ASTM A500/A500M, Grade C, structural tubing.

E. Steel Pipe: ASTM A53/A53M, Type E, Grade B.

F. Steel Castings: ASTM A216/A216M, Grade WCB with supplementary requirement S11.

G. Steel Forgings: ASTM A668/A668M.

H. Welding Electrodes: Comply with AWS requirements. Provide E70 electrodes unless indicated otherwise.

I. Headed Anchors and Threaded Studs:
   1. As manufactured by Nelson Division of TRW, or equal conforming to ASTM A108 and AWS D1.1/D1.1M.
   2. Minimum Fu = 65 ksi.

2.02 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, heavy-hex steel structural bolts; ASTM A563/A563M, Grade C, Class 8S heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.
   1. Minimum Diameter: 3/4 inch (76 mm).

B. Zinc-Coated High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, heavy-hex steel structural bolts; ASTM A563/A563M, Grade DH, Class 10S heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.
   1. Finish: Hot-dip zinc coating.

C. Headed Anchor Rods: ASTM F1554, Grade 36, or Grade 105 (As indicated on the drawings) straight.
   1. Nuts: ASTM A563/A563M hex carbon steel.
   2. Plate Washers: ASTM A36/A36M carbon steel.
   3. Washers: ASTM F436/F436M, Type 1, hardened carbon steel.
   4. Finish: Plain.

2.03 NON-SHRINK GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, non-corrosive and non-staining, mixed with water to consistency suitable for application and a 30-minute working time.
   1. Acceptable Products:
      1) Masterflow 713 Plus by BASF Building Systems.
      2) Crystex by L&M Construction Chemicals, Inc.
      3) 1107 Advantage Grout by Dayton Superior.
      4) NS Grout by Euclid.

2.04 WATER PROTECTIVE COATING

A. Basis of Design.
   1. Carboline - “Bitumastic No. 50” or "Bitumastic 300M"

B. Other acceptable products:
   1. Rustoleum - "Coal Tar Epoxy C9578"
   2. Carboline - "Carboguard 635"
   3. Carboline - "Carbomastic 615"
   4. Or approved equal.

2.05 PRIMER

A. Primer: SSPC-Paint 15, or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15, lead- and chromate-free, nonasphaltic, rust-inhibiting, complying with MPI (APSM) #79 and compatible with topcoat.

2.06 ANCHORS

A. Adhesive Anchors: Size and embedment indicated on Drawings:
   1. Provide product indicated on drawings. (No Substitutions)

B. Expansion Anchors: Size and embedment indicated on Drawings.
   1. Provide product indicated on drawings. (No Substitutions)

C. Screw Anchors: Size and embedment indicated on Drawings.
   1. Provide product indicated on drawings. (No Substitutions)

2.07 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate per AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360.
   1. Camber structural-steel members where indicated.
   2. Fabricate beams with rolling camber up.
   3. Identify high-strength structural steel per ASTM A6/A6M and maintain markings until structural steel has been erected.
   4. Mark and match-mark materials for field assembly.
   5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Holes: Provide holes required for securing other Work to structural steel and for other Work to pass through steel framing members.
   1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
   2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
   3. Weld threaded nuts to framing and other specialty items indicated to receive other Work.

2.08 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts per RCSC (HSBOLT) "Specification for Structural Joints Using High Strength Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding Work.
   1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

2.09 SHOP PRIMING

A. Shop prime steel surfaces except the following:
   1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50.8 mm).
   2. Surfaces to be field welded.
   3. Galvanized surfaces.

B. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79, VOC requirements in 09 91 00 Painting and compatible with topcoat.

C. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces per the following specifications and standards:
   1. SSPC-SP 2, "Hand Tool Cleaning."
   2. SSPC-SP 3, "Power Tool Cleaning."
   3. SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
   4. SSPC-SP 10/NACE No. 2, "Near-White Blast Cleaning."

D. Priming: Immediately after surface preparation, apply primer per manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
   1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
   2. Apply 2 coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

E. Painting: Prepare steel and apply a 1-coat, non-asphaltic primer complying with SSPC-PS Guide 7.00, "Painting System Guide 7.00: Guide for Selecting One-Coat Shop Painting Systems," to provide a dry film thickness of not less than 1.5 mils (0.038 mm).

2.10 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by hot-dip process to structural steel per ASTM A123/A123M.
   1. Fill vent and drain holes that will be exposed in finished Work unless they will function as weep holes, by plugging with zinc solder and filing off smooth.
   2. Galvanize lintels and shelf angles attached to structural-steel frame and located in exterior walls.

B. Galvanizing Repair Paint: ASTM A780/A780M.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.
   1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.03 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and per AISC 303 and AISC 360.

B. Base Bearing and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
   1. Set plates for structural members on wedges, shims, or setting nuts as required.
   2. Weld plate washers to top of baseplate when indicated on drawings.
   3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
   4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure.

C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
   1. Level and plumb individual members of structure.
   2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

E. Splice members only where indicated.

F. Do not use thermal cutting during erection.

G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

H. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors per AWS D1.1/D1.1M and manufacturer's written instructions.

3.04 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts per RCSC's "Specification for Structural Joints Using High Strength Bolts" for type of bolt and type of joint specified.
   1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding Work.
   1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
   2. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.

3.05 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect items listed in drawings and in section 01 45 33.

B. Bolted Connections: Bolted connections will be tested and inspected per RCSC's "Specification for Structural Joints Using High Strength Bolts."

C. Welded Connections: Field welds will be visually inspected per AWS D1.1/D1.1M. In addition to visual inspection, test and inspect field welds in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
   1. Liquid Penetrant Inspection: ASTM E165/E165M.

2. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
3. Ultrasonic Inspection: ASTM E164.
4. Radiographic Inspection: ASTM E94/E94M.

D. Shear Stud Connectors: In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to headed studs and shear connectors.
2. Conduct tests on additional shear connectors if weld fracture occurs on headed studs and shear connectors already tested, per requirements in AWS D1.1/D1.1M.

E. Expansion Bolting and Adhesive Anchoring in concrete members: Per IBC Table 1705.3, verify bolt type and dimensions, concrete type and compressive strength, pre-drilled hole dimensions, embedment, spacing, edge distances, slab thickness, and tightening torque. Whether inspections are required to be continuous or periodic.

F. Correct deficiencies in Work that test reports and inspections indicate does not comply with Contract Documents.

END OF SECTION

SECTION 05 1219
BUCKLING-RESTRAINED BRACES

PART 1 GENERAL

1.01 SUMMARY

A. Provide all parts, materials, and labor required for the design, delivery, testing and erection of buckling-restrained braces, which are designed by the manufacturer to meet stiffness, yield strength, and elongation requirements as indicated on the Drawings and other requirements specified Herein.

B. Related Sections
   1. Section 05 12 00-Structural Steel

1.02 RELATED SECTIONS

A. Section 01 31 00 - Project Management and Coordination.

B. Section 01 31 00.05 - Project BIM Coordination.

C. Section 01 33 00 - Submittal Procedures.

D. Section 01 40 00 - Quality Requirements.

E. Section 01 45 33 - Code-Required Special Inspections and Procedures.

F. Section 01 60 00 - Product Requirements.

G. Section 03 20 00 - Concrete Reinforcement.

H. Section 03 30 00 - Cast in Place Concrete.

I. Section 05 12 00 - Structural Steel Framing.

J. Section 05 31 00 - Steel Decking.

K. Section 05 40 00 - Cold Formed Metal Framing.

1.03 REFERENCES

A. The following applicable standards are to be adhered to unless indicated otherwise.

B. American Institute of Steel Construction (AISC):
   1. “Code of Standard Practice for Steel Buildings and Bridges”, latest edition.
   2. 2010 Seismic Provisions for Structural Steel Buildings (ANSI/AISC 341-10)

C. American Society for Testing and Materials (ASTM) Standard Specifications:
   1. A6 – Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling, latest edition.
   2. A36 – Specification for Carbon Structural Steel, latest edition.
   3. A325– Specification for Structural Bolts, 120/105 ksi Minimum Tensile Strength, latest edition.
   4. A490 – Specification for Structural Bolts, 150 ksi Minimum Tensile Strength, latest edition.
   5. A500 – Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes, latest edition.
   6. A572 – Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel, latest edition.
   7. F959 – Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners, latest edition.
   8. F1852 – Specification for “Twist-off” Type Tension Control Structural Bolts, 120/105 ksi Minimum Tensile Strength, latest edition
   9. F2280 – Specification for “Twist-off” Type Tension Control Structural Bolts, 150 ksi Minimum Tensile Strength, latest edition

D. American Welding Society (AWS):
   1. AWS A2.4 – Standard Symbols for Welding, Brazing and Nondestructive Examination.
   2. A5.1 –Specification for Carbon Steel Electrodes
   3. A5.18 –Specification for Carbon Steel Electrodes and Rods for Gas Shielded Arc Welding

4. A5.20 – Carbon Steel Electrodes for Flux Cored Arc Welding
5. D1.1 – Structural Welding Code-Steel, latest edition.

E. Steel Structures Painting Council (SSPC):
1. Steel Structures Painting Manual, latest edition.

1.04 DEFINITIONS

A. Buckling-Restrained Brace (BRB): A steel brace consisting of an outer steel casing, an inner steel core, and a concrete matrix between the core and the outer steel casing. The inner steel core resists against tensile and compressive axial loads and is restrained from buckling by the concrete contained in the outer steel casing.

1.05 SUBMITTALS

A. The following submittals shall be made.

B. Proposed Design of Buckling-Restrained Braces:
1. Design Drawings shall clearly display size, thickness and length of exterior brace casing as well as configuration and size of the full length of the core plates.
2. Calculations shall be provided to display the ability of the proposed “BRB’s” to meet the Performance Criteria described herein.
3. The Design Drawings and Calculations shall be sealed and stamped by a Structural/Professional Engineer (S.E.) licensed in the State of Utah.
4. Preliminary design: At contractor’s option, make an initial submittal of the above items without sealed S.E. stamp for review by project Structural Engineer of Record, Architect and Jurisdictional Authority and coordination with structural steel contractor. Once all reviews are complete and incorporated, resubmit with sealed S.E. stamps for record.

C. Shop Drawings:
1. Shop drawings shall clearly display all geometries necessary to manufacture BRB’s including plate thickness, lengths, plate dimensions inside and outside of the casing, and casing dimensions.
2. Shop drawings shall clearly display all connection information including location of bolts, bolt types, bolt diameters, hole size, and faying surface types.

D. Material Test Reports:
1. Tensile tests and chemical analysis for all steel.
2. Independent coupon tests used to verify core plate initial yield stress, tensile stress, and ultimate elongation.
   a. Where core plates are fabricated from plate material, coupon tests shall be performed on each plate.
   b. Where core plates are fabricated from bar stock, coupons shall be made at intervals of each 5 tons of material of same heat and thickness.
   c. Coupon tests to be taken at point of manufacture. Mill test reports (MTR) may not be used.
3. Plates 2 inches (50mm) and thicker shall be supplied with Charpy V-Notch testing in accordance with ASTM A673, Frequency P, or approved equal. The impact test shall meet a minimum average value of 20 ft-lbs absorbed energy at +70 degrees Fahrenheit and shall be conducted in accordance with AISC Specification, or approved equal.

E. Technical Report:
1. The Manufacturer shall submit a BRB testing report. The testing configurations used, and the results obtained shall meet the criteria found in the AISC 2010 Seismic Provisions (341-10).

F. Welding Certificates:
1. Welder Performance Qualification Records (WPQR’s)
2. Welding Procedure Specification (WPS) written in conformance with AWS D1.1 for each proposed type of welded joint, whether pre-qualified or qualified by testing.

G. Manufacturer’s Quality Assurance Plan.

H. Manufacturer's in-house Quality Assurance Inspection Report for each brace upon completion of fabrication.

I. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.
   3. See Sections 01 33 00 and 01 60 00.

J. Outside Testing Agency Quality Control Report where applicable.

1.06 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. The Manufacturer shall have a detailed Quality Assurance Plan.
   1. The Quality Assurance Plan shall contain the procedures for manufacturing buckling-restrained braces including:
      a. Welding procedures.
      b. Methodology for verifying and documenting material properties.
      c. Indication of how the product is to be identified, such that it can be traced back to production quality assurance records.
      d. A flow chart of the process by which the product is manufactured, including description of production methods.
      e. Identified manufacturing tolerances for each production process.
      f. In-process quality control including all points of internal inspection for control and monitoring of the fabrication and assembly process.
   2. Design Engineer Requirements: The Structural Engineer designing the BRBs shall be registered in the State of California, have experience with designing buckling-restrained braced frame systems, and have a thorough knowledge of the submitted BRB test report.
   3. Qualification testing shall conform to Article 2.5.

C. The Manufacturer shall notify Owner of fabrication schedule at least 30 days prior to fabrication in order to allow Owner or Owner's Representative to observe fabrication process.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Plants fabricating buckling-restrained braces shall comply with the following:
   1. Obtain and maintain accreditation from The American Institute of Steel Construction (AISC Certified Fabricator) in conjunction with any additional certifications required by the local jurisdiction.
   2. Have a minimum of 5 years of documented continuous experience in the fabrication of buckling-restrained braces with a minimum of 30 completed projects over this same period.
   3. Buckling-restrained braces for this project shall be manufactured in the same facility (following the same quality assurance procedures) as the braces manufactured and tested to fulfill the AISC 341 testing requirements.

B. Buckling-Restrained Braces shall be manufactured and supplied by the following vendor or Engineer of Record approved equal.
   1. CoreBrace, LLC
      5789 West Wells Park Road
      West Jordan, UT 84081
      801.280.0701

C. Documentation showing evidence of valid accreditation and experience shall be submitted to the Engineer of Record during the bidding phase for any proposed manufacturer not listed above.

2.02 MATERIALS

A. Core Plate:
   1. ASTM A36 with Fy as noted on the drawings.
      a. Fy of all core plate material shall be verified via coupon test per Article 1.4.D.2.
      b. Core plates 2 inches (50mm) and thicker shall be supplied with Charpy V-Notch testing per Article 1.4.D.3.
      c. If not noted on the drawings, use 38ksi ≤ Fy ≤ 46ksi

B. Casing:
   1. ASTM A500, Gr. B or similar for square or rectangular sections.
   2. ASTM A500, Gr. B or A53, Gr. B or similar for round sections.

C. Primer:
   1. Standard shop primer.

D. Bolts, Nuts, and Washers:
   1. ASTM A325 or A490 for conventional high-strength bolts, ASTM A563 nuts.
   2. ASTM 1852 or F2280 for twist-off type Tension Control Bolt/Nut/Washer Assemblies.

E. Welding Materials:
   1. Shielded metal arc welding electrodes conform to AWS A5.1, flux-cored arc welding electrodes conform to AWS A5.20, and electrodes used for gas metal arc or submerged arc conform to the requirements of AWS A5.18.
   2. The minimum tensile strength of the E70 class electrodes used in production is 70,000 psi (470 MPa).
   3. Materials shall provide production welds with minimum Charpy V Notch properties of 20 ft-lbs (27 J) at -20°F (-30 C).

F. Infill Grout:
   1. Manufacturer's standard infill that has been demonstrated suitable by sub-assemblage testing per the Recommended Provisions.

2.03 DESIGN REQUIREMENTS

A. A Structural Engineer shall design the buckling-restrained braces to meet the Performance Requirements. The Structural Engineer shall have a thorough knowledge of the qualifying cyclical tests and competently apply the test results to the Project conditions.

B. Interpolation or extrapolation of test results for different member sizes shall be justified by rational analysis that demonstrates stress distributions and magnitudes of internal strains that are consistent with or less severe than the tested assemblies and that considers the adverse effects of larger material and variations in material properties.

C. Stability calculations shall include beams, columns and gussets adjoining the BRB's.

D. End rotation effects corresponding to the larger of 2.0 times Design Story Drift or .025 radians minimum shall be considered.

E. Where bracing connections are designed by manufacturer they shall be designed to a minimum of 1.1 times the adjusted brace strength as defined in Article 2.4.F.

2.04 PERFORMANCE REQUIREMENTS

A. Core plate material shall have a yield range of 42 ksi within ±4 ksi unless indicated otherwise in the structural BRB drawings. Coupon tests taken from plates at point of manufacture of BRBs shall be used to verify conformance. Additional coupon tests may be performed to replace coupon tests that fall out of acceptable range.

B. Increasing amplitude cyclic displacement tests per the AISC Seismic Provisions shall provide stable performance up to a displacement corresponding to 2.0 x Design Story Drift.
   1. Hysteretic behavior shall display no post-yield loss of strength, degradation, or pinching.
   2. Fracture of any portion of the BRB shall not occur during the qualifying tests.

3. The cumulative ductility factor requirement specified in AISC 341 shall be increased from 200 to 300.

C. The steel core shall resist compression and tension forces. The steel core area shall be as per the project drawings and based on the yield stress range specified.

D. The steel and concrete casing shall prevent the steel core from buckling globally and locally during compressive loading without binding due to longitudinal shortening and transverse expansion. Demand for local and global stability of casing checks shall be based on the adjusted brace strength at the maximum yield stress (Fysc,max) of the specified yield stress range of the core plate material.

E. Steel core projections beyond the steel casing and brace connections shall develop the adjusted brace strength without instigation of fracture or instability. For core plate checks use the minimum (Fysc,min) of the specified yield stress range for determining demand. For all other materials use Fysc,max to determine demand.

F. The overstrength factors (w, b) shall be determined at a brace strain level associated with the greater of a 2% interstory drift or twice the design story drift, the latter of which is taken as (2fCdFysc,min)/(ρIeE). Where Pd is provided, twice the design story drift is taken as (2CdPd)/(AscρIeE). Cd is the design drift deflection amplification factor, E is the nominal modulus of elasticity of the core plate material, Ie is the Importance Factor, is the Redundancy Factor, and Pd is the demand in the BRBs at the controlling drift design load case with gravity loads excluded.

2.05 QUALIFICATION TESTS

A. Buckling-restrained brace design shall be based on two qualifying cyclic tests conforming to the AISC Seismic Provisions for Buckling Restrained Braced Frames. As stated in the Provisions, at least one of the two qualifying tests needs to be a subassemblage test to demonstrate the ability of the BRB to withstand rotational demands. The other test may be performed uniaxially or may also be a subassemblage test.

B. The requirements of the AISC 341 Seismic Provisions shall be met along with the modification in Article 2.4.B.3.

C. The strain level during testing shall be equivalent to, or greater than, the strains that the project braces will be expected to withstand.

D. Qualifying cyclical tests can be based on full-scale cyclical tests previously reported for projects, or research that are deemed similar to project conditions by the Manufacturer and Project Engineer.

PART 3 EXECUTION

3.01 FABRICATION

A. Braces shall be fabricated in accordance with AISC Code of Standard Practice and in an AISC Certified Shop that participates in the AISC Quality Certification Program.

B. Core plates shall be cut to profile shown on Design Drawings.
   1. The general roughness cannot exceed 1000 micro-inches in the yielding length.
   2. Notches in yield length region up to 1/8–inch may be repaired by grinding to a smooth transition. The length of the transition shall not be less than 10 times the notch depth.
   3. Notches in the yielding length region greater than 1/8–inch and less than or equal to 3/8–inch may be repaired using procedures outlined in the Company Quality Assurance Manual. The repairs shall be examined using Ultrasonic Testing (UT) procedures in conformance with AWS D1.1.
   4. Notches in the yielding length region greater than 3/8–inch in the yield length shall be rejected.

C. No splices are allowed in the yielding region of the steel core plate.

D. Minimum casing dimensions shall be as required by manufacturer or as specified on the project documents.

E. Holes for bolted connections may be drilled, cut or punched in conformance with AISC standards and burs removed.

F. Finish shall be manufacturer's standard shop primer. Do not paint connection faying surfaces if connection are designated slip critical unless paint used provides same slip resistance

G. Assembly of the different components of the brace shall be done in accordance with the manufacturer's Quality Assurance Manual in a manner that ensures proper performance of the brace.

H. Pin-connection hole tolerance shall be +1/32", -0".

3.02 SHIPPING

A. Manufacturer to package BRB's for protection against shipping damage.

B. Manufacturer shall coordinate delivery dates and quantities with Contractor/Owner. Contractor/Owner shall provide adequate storage space and proper lay-down areas.

C. Braces shall be stored on dunnage not touching the ground.

D. Coordinate erection aid requirements with contractor/Owner.

3.03 ERECTION

A. Braces are to be erected under the Structural Steel Specification Section and according to referenced AISC Specifications.

B. Prior to erection, clean faying surfaces of BRB to be in contact with bolted connections to remove temporary coatings applied for transport and surface contaminants.

C. Manufacturer shall coordinate with Owner's Representative to verify proper BRB dimensions.

D. Allow for erection loads and for sufficient temporary bracing to maintain structure safe, plumb, and in true alignment until completion of erection and installation of buckling-restrained braces.

E. No field welding to BRB's is allowed, including non-structural pieces unless approved by manufacturer and Engineer of Record (EOR).

F. No field cutting or altering is permitted without the approval of the manufacturer and EOR.

END OF SECTION

SECTION 05 3100
STEEL DECKING

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes the following:
   1. Roof deck.
   2. Form Deck.
   3. Composite Deck.

1.02 RELATED SECTIONS

A. Section 01 31 00 - Project Management and Coordination.

B. Section 01 31 00.05 - Project BIM Coordination.

C. Section 01 33 00 - Submittal Procedures.

D. Section 01 40 00 - Quality Requirements.

E. Section 01 45 33 - Code-Required Special Inspections and Procedures.

F. Section 01 60 00 - Product Requirements.

G. Section 03 20 00 - Concrete Reinforcement.

H. Section 03 30 00 - Cast in Place Concrete.

I. Section 05 12 00 - Structural Steel Framing.

J. Section 05 12 19 - Buckling Restrained Braces.

K. Section 05 40 00 - Cold Formed Metal Framing.

L. Section 05 50 00 - Metal Fabrications.

M. Section 05 51 00 - Metal Stairs.

N. Section 07 54 23 - Thermoplastic Polyolefin (TPO) Roofing.

O. Section 07 81 00 - Applied Fireproofing.

P. Section 07 81 60 - Intumescent Fireproofing.

Q. Section 09 91 00 - Painting.

1.03 REFERENCE STANDARDS

A. AISC 303 Code of Standard Practice for Steel Buildings and Bridges.

B. AISC 360 Specification for Structural Steel Buildings.

C. ASTM A53/A53M Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

D. ASTM A216/A216M Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service.

E. ASTM A500/A500M Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

F. ASTM A572/A572M Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.

G. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

H. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2020.

I. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2023, with Editorial Revision.

J. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.

K. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection; 2023.

L. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).

M. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).

N. SDI (DM) Steel Decking Institute; Publication No.30, Design Manual for Composite Decks, Form Decks, and Roof Decks.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Work Completed under this section must be coordinated with other work using BIM modelling. See Section 01 31 00.05 for requirements.

1.05 SUBMITTALS

A. Product Data: For each type of deck, accessory, and product indicated.

B. Submit BIM models as required by Section 01 31 00.05.

C. Shop Drawings:
   1. Show layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction, including field fastening pattern and sidelap fastener type and pattern.
   2. Shop Drawing submittals must conform with coordinated BIM models. See Section 01 31 00.05.
   3. Show compliance with specified deck section and material properties as indicated on construction documents. Decking shall meet or exceed all specified properties.
   4. Shear stud layouts showing the number, pattern, spacing and configuration of the shear studs for each beam and girder.
   5. At composite deck, provide max unshored clear span tables for each deck gauge and concrete thickness shown.
      a. Deck to be designed per ANSI/SDI-C-1.0.
   6. Phasing diagram, if applicable, indicating scope of work for each phase of work.
   7. Changes from construction documents:
      a. Cloud and clearly identify all changes or deviations from the construction documents.

D. Product Certificates: For each type of steel deck, signed by product manufacturer.

E. Welding certificates.

F. Perform and submit reports of Code Required Special Inspections as required in Section 01 45 33.

G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
   1. Power-actuated mechanical fasteners.
   2. Acoustical roof deck.

H. Research/Evaluation Reports: For steel deck.

I. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.
   3. See Sections 01 33 00 and 01 60 00.

1.06 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Testing Agency Qualifications: An independent agency qualified according to ASTM E329 for testing indicated.

C. Welding: Qualify procedures and personnel according to AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

D. Mechanical Fasteners: Qualify mechanical fastening systems, procedures, and personnel in accordance with the "Standard for Quality Control and Quality Assurance for Installation of Steel Deck" from ANSI / SDI and with Manufacturer's qualification standards.

E. Fire-Test-Response Characteristics: Where indicated, provide steel deck units identical to those tested for fire resistance per ASTM E119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
   1. Fire-Resistance Ratings: Indicated by design designations of applicable testing and inspecting agency.
   2. Steel deck units shall be identified with appropriate markings of applicable testing and inspecting agency.

F. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

G. FMG Listing: Provide steel roof deck evaluated by FMG and listed in its "Approval Guide, Building Materials" for Class 1 fire rating and Class 1-90 windstorm ratings.

H. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of pre-consumer recycled content is not less than 25 percent.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.
   1. Protect and ventilate acoustical cellular roof deck with factory-installed insulation to maintain insulation free of moisture.

1.08 COORDINATION

A. Coordinate installation of sound-absorbing insulation strips in topside ribs of acoustical deck with roofing installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Steel Deck:
      a. ASC Profiles, LLC.
      b. Canam Steel Corporation.
      c. Consolidated Systems, Inc., Metal Dek Group.
      d. DACS, Inc.
      e. D-Mac Industries Inc.
      f. Epic Metals Corporation.
      g. Marlyn Steel Decks, Inc.
      h. New Millennium Building Systems, LLC.
      i. Nucor Corp.; Vulcraft Division.
      j. Roof Deck, Inc.
      k. United Steel Deck, Inc.
      l. Valley Joist , Inc., Division of EBSCO Industries, Inc.
      m. Verco Decking, Inc.v a NUCOR company.

2.02 NON-COMPOSITE ROOF DECK

A. Steel Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 30, and with the following:
   1. Prime-Painted Steel Sheet: ASTM A1008/A1008M, Structural Steel (SS), Grade 540 minimum, shop primed with manufacturer's standard baked-on, rust-inhibitive primer.

a. Color: Manufacturer's standard.
2. Galvanized Steel Sheet: ASTM A653/A653M, Structural Steel (SS), Grade 540 or higher.
a. Color: Manufacturer's standard.
3. Deck Profile: As indicated on drawings.
4. Profile Depth: As indicated on drawings.
5. Design Uncoated-Steel Thickness: As indicated on drawings.
6. Span Condition: 3-span minimum.
7. Side Laps: Overlapped.

2.03 COMPOSITE METAL DECK

A. Composite Metal Decking: ASTM A653/A653M or ASTM A1008/A1008M Grade 50 or higher, cold rolled steel sheet, 24” or 36" wide sheets.
1. Deck profile: As indicated on drawings.
2. Profile depth: As indicated on drawings.
3. Design thickness: As indicated on drawings.
4. Span condition: 3-span minimum.
a. Where 3-span conditions cannot be met, or framing configuration does not permit for 3-span condition, increase deck gauge as necessary to enable unshored construction.
5. Finish: Galvanized G60 or phosphatized and painted, or as indicated in architectural drawings.

2.04 DECK FASTENING AT SUPPORTS

A. Mechanical fasteners, screwed, pneumatic driven or powder driven, as manufactured by ITW Buildex, Hilti, or Pneutek, may be substituted for welds with the following requirements:
1. Exception: Exposed structure shall have welded sidelap fasteners per the drawings.
2. Design the fastener layout to provide a roof diaphragm of equivalent strength and stiffness to that shown on the Drawings.

B. Provide certified structural calculations and ICC Evaluation report for all fastener types indicating diaphragm values for metal deck gauge and substrate thickness.
1. Coordinate fastener requirements for the different substrate thickness with the structural steel and joist suppliers.
2. Submit certified roof fastener layout shop drawings clearly showing fastener types, layout, and installation requirements.
3. Provide training as required by the installing contractor and Owner’s testing laboratory to assure proper installation.
4. Owner’s testing laboratory will inspect the work in accordance with Field Quality Control requirements specified in this Section in addition to field verifying substrate thickness of beam flanges and joist top chords, and fastener type.

2.05 ACCESSORIES

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 (4.8-mm) minimum diameter.

D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi (230 MPa), not less than 0.0359-inch (0.91-mm) design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

F. Recessed Sump Pans: Single-piece steel sheet, 0.0747 inch (1.90 mm) thick, of same material and finish as deck, with 3-inch- (76-mm-) wide flanges and level recessed pans of 1-1/2-inch (38-mm) minimum depth. For drains, cut holes in the field.

G. Flat Sump Plate: Single-piece steel sheet, 0.0747 inch (1.90 mm) thick, of same material and finish as deck. For drains, cut holes in the field.

H. Galvanizing Repair Paint: ASTM A780/A780M, SSPC-Paint 20 or DOD-P-21035, with dry film containing a minimum of 94 percent zinc dust by weight.

I. See Specification Section 05 12 00 for steel headed studs.

J. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

3.02 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 30, manufacturer's written instructions, and requirements in this Section.

B. Install decking and accessories as noted in deck shop drawings, including shortened deck widths arranged to minimize cutting deck and using fillers at structural steel girders.

C. Install temporary shoring before placing deck panels, if required to meet deflection or strength limitations.

D. Locate deck bundles to prevent overloading of supporting members.

E. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
   1. Align cellular deck panels over full length of cell runs and align cells at ends of abutting panels.

F. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

G. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

H. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

I. Comply with AWS D1.1/D1.1M requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

J. Immediately after welding deck in place, touch-up welds, burned areas, and surface coating damage with prime paint.

K. Additional Composite deck requirements:
   1. Install side lap fasteners 12”oc maximum, or as indicated in Drawings, whichever is more stringent.
   2. Confirm that all plies are in contact upon fastening.
   3. Openings in bare deck shall be reinforced.
   4. Coring of deck to occur only after concrete is placed and has reached 75% of design strength.
   5. Deck installer to follow reviewed shop drawings with respect to layout, fillers, and fastening, including the strategy of starting bays with special sized deck width so low flute lands on an interior girder.
   6. Ensure sufficient deck end bearing length (SDI minimum or greater) and side bearing width (for fasteners).
   7. Do not scorch top flute of deck when installing headed studs. Damaged deck shall be replaced.
   8. Do not use a hammer to stretch side margins of deck to reach supports. Where deck does not reach supports, the contractor shall submit proposed solution for review to the Engineer for approval.
   9. Provide 3-span, minimum. Where 3-span conditions cannot be met, or framing configuration does not permit 3-span condition, increase deck gauge as necessary to enable unshored construction.

10. Contractor may shore deck at their discretion. Shoring shall be beam-to-beam and may not be supported from floor(s) below.

3.03 DECK INSTALLATION

A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches (38 mm) long, and as follows:
   1. Weld Diameter: 5/8 inch (16 mm)
   2. Weld Spacing: Weld edge and interior ribs of deck units with a minimum of one welds per deck unit at each support, unless noted otherwise on drawings.

B. Shear Studs:
   1. A welded headed stud may take the place of a puddle weld at composite deck.
   2. Weld studs through a singly ply of deck, placing studs directly over beam web.
   3. Use ferrules developed for weld-through technique. Remove after welding.

C. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports as indicated.
   1. Roof Deck - Mechanically fasten with self-drilling, No. 10 (4.8-mm-) diameter or larger, carbon-steel TEK screws.
   2. Composite and Form Deck - Mechanically fasten by button punching at 12” oc ,or with self-drilling No. 10 diameter or larger, carbon-steel TEK screws at 12” oc, unless noted otherwise on structural drawings.

D. Install deck ends over supports with bearing lengths as follows:
   1. Roof Deck (B, N):
      a. End bearing: 2"
      b. Interior bearing: 3"
   2. Floor Deck (Composite):
      a. End bearing on steel: 2"
      b. Interior bearing on steel: 4"
      c. End or interior on bare concrete or masonry supports: 4"

E. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and mechanically fasten flanges to top of deck. Space mechanical fasteners not more than 12 inches (305 mm) apart with at least one fastener at each corner.
   1. Fasten metal roof deck at 6” oc at deck opening framing.
   2. Install reinforcing channels or zees in ribs to span between supports and mechanically fasten.

F. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld or mechanically fasten to substrate to provide a complete deck installation.
   1. Fasten cover plates at changes in direction of roof-deck panels, unless otherwise indicated.

G. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

H. Sound-Absorbing Insulation: Installation into topside ribs of deck per manufacturer’s recommendations.

3.04 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field welds will be subject to inspection.

C. Testing agency will report inspection results promptly and in writing to Contractor and Architect.

D. Remove and replace work that does not comply with specified requirements.

E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.05 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.

B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.
   1. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.
   2. Wire brushing, cleaning, and repair painting of bottom deck surfaces are included in Division 9 Section 09 91 00 - Painting.

C. Repair Painting: Wire brushing, cleaning, and repair painting of rust spots, welds, and abraded areas of both deck surfaces are included in Division 9 Section 09 91 00 - Painting.

D. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION

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SECTION 05 31 00
STEEL DECKING

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes the following:
   1. Roof deck.
   2. Form Deck.
   3. Composite Deck.

1.02 RELATED SECTIONS

A. Section 01 31 00 - Project Management and Coordination.

B. Section 01 31 00.05 - Project BIM Coordination.

C. Section 01 33 00 - Submittal Procedures.

D. Section 01 40 00 - Quality Requirements.

E. Section 01 45 33 - Code-Required Special Inspections and Procedures.

F. Section 01 60 00 - Product Requirements.

G. Section 03 20 00 - Concrete Reinforcement.

H. Section 03 30 00 - Cast in Place Concrete.

I. Section 05 12 00 - Structural Steel Framing.

J. Section 05 12 19 - Buckling Restrained Braces.

K. Section 05 40 00 - Cold Formed Metal Framing.

L. Section 05 50 00 - Metal Fabrications.

M. Section 05 51 00 - Metal Stairs.

N. Section 07 54 23 - Thermoplastic Polyolefin (TPO) Roofing.

O. Section 07 81 00 - Applied Fireproofing.

P. Section 07 81 60 - Intumescent Fireproofing.

Q. Section 09 91 00 - Painting.

1.03 REFERENCE STANDARDS

A. AISC 303 Code of Standard Practice for Steel Buildings and Bridges.

B. AISC 360 Specification for Structural Steel Buildings.

C. ASTM A53/A53M Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

D. ASTM A216/A216M Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service.

E. ASTM A500/A500M Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

F. ASTM A572/A572M Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.

G. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

H. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2020.

I. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2023, with Editorial Revision.

J. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.

K. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection; 2023.

L. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).

M. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).

N. SDI (DM) Steel Decking Institute; Publication No.30, Design Manual for Composite Decks, Form Decks, and Roof Decks.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Work Completed under this section must be coordinated with other work using BIM modelling. See Section 01 31 00.05 for requirements.

1.05 SUBMITTALS

A. Product Data: For each type of deck, accessory, and product indicated.

B. Submit BIM models as required by Section 01 31 00.05.

C. Shop Drawings:
   1. Show layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction, including field fastening pattern and sidelap fastener type and pattern.
   2. Shop Drawing submittals must conform with coordinated BIM models. See Section 01 31 00.05.
   3. Show compliance with specified deck section and material properties as indicated on construction documents. Decking shall meet or exceed all specified properties.
   4. Shear stud layouts showing the number, pattern, spacing and configuration of the shear studs for each beam and girder.
   5. At composite deck, provide max unshored clear span tables for each deck gauge and concrete thickness shown.
      a. Deck to be designed per ANSI/SDI-C-1.0.
   6. Phasing diagram, if applicable, indicating scope of work for each phase of work.
   7. Changes from construction documents:
      a. Cloud and clearly identify all changes or deviations from the construction documents.

D. Product Certificates: For each type of steel deck, signed by product manufacturer.

E. Welding certificates.

F. Perform and submit reports of Code Required Special Inspections as required in Section 01 45 33.

G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
   1. Power-actuated mechanical fasteners.
   2. Acoustical roof deck.

H. Research/Evaluation Reports: For steel deck.

I. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.
   3. See Sections 01 33 00 and 01 60 00.

1.06 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Testing Agency Qualifications: An independent agency qualified according to ASTM E329 for testing indicated.

C. Welding: Qualify procedures and personnel according to AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

D. Mechanical Fasteners: Qualify mechanical fastening systems, procedures, and personnel in accordance with the "Standard for Quality Control and Quality Assurance for Installation of Steel Deck" from ANSI / SDI and with Manufacturer's qualification standards.

E. Fire-Test-Response Characteristics: Where indicated, provide steel deck units identical to those tested for fire resistance per ASTM E119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
   1. Fire-Resistance Ratings: Indicated by design designations of applicable testing and inspecting agency.
   2. Steel deck units shall be identified with appropriate markings of applicable testing and inspecting agency.

F. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

G. FMG Listing: Provide steel roof deck evaluated by FMG and listed in its "Approval Guide, Building Materials" for Class 1 fire rating and Class 1-90 windstorm ratings.

H. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of pre-consumer recycled content is not less than 25 percent.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.
   1. Protect and ventilate acoustical cellular roof deck with factory-installed insulation to maintain insulation free of moisture.

1.08 COORDINATION

A. Coordinate installation of sound-absorbing insulation strips in topside ribs of acoustical deck with roofing installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Steel Deck:
      a. ASC Profiles, LLC.
      b. Canam Steel Corporation.
      c. Consolidated Systems, Inc., Metal Dek Group.
      d. DACS, Inc.
      e. D-Mac Industries Inc.
      f. Epic Metals Corporation.
      g. Marlyn Steel Decks, Inc.
      h. New Millennium Building Systems, LLC.
      i. Nucor Corp.; Vulcraft Division.
      j. Roof Deck, Inc.
      k. United Steel Deck, Inc.
      l. Valley Joist , Inc., Division of EBSCO Industries, Inc.
      m. Verco Decking, Inc.v a NUCOR company.

2.02 NON-COMPOSITE ROOF DECK

A. Steel Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 30, and with the following:
   1. Prime-Painted Steel Sheet: ASTM A1008/A1008M, Structural Steel (SS), Grade 540 minimum, shop primed with manufacturer's standard baked-on, rust-inhibitive primer.

a. Color: Manufacturer's standard.

2. Galvanized Steel Sheet: ASTM A653/A653M, Structural Steel (SS), Grade 540 or higher.
   a. Color: Manufacturer's standard.
3. Deck Profile: As indicated on drawings.
4. Profile Depth: As indicated on drawings.
5. Design Uncoated-Steel Thickness: As indicated on drawings.
6. Span Condition: 3-span minimum.
7. Side Laps: Overlapped.

2.03 COMPOSITE METAL DECK

A. Composite Metal Decking: ASTM A653/A653M or ASTM A1008/A1008M Grade 50 or higher, cold rolled steel sheet, 24” or 36" wide sheets.
   1. Deck profile: As indicated on drawings.
   2. Profile depth: As indicated on drawings.
   3. Design thickness: As indicated on drawings.
   4. Span condition: 3-span minimum.
      a. Where 3-span conditions cannot be met, or framing configuration does not permit for 3-span condition, increase deck gauge as necessary to enable unshored construction.
   5. Finish: Galvanized G60 or phosphatized and painted, or as indicated in architectural drawings.

2.04 DECK FASTENING AT SUPPORTS

A. Mechanical fasteners, screwed, pneumatic driven or powder driven, as manufactured by ITW Buildex, Hilti, or Pneutek, may be substituted for welds with the following requirements:
   1. Exception: Exposed structure shall have welded sidelap fasteners per the drawings.
   2. Design the fastener layout to provide a roof diaphragm of equivalent strength and stiffness to that shown on the Drawings.

B. Provide certified structural calculations and ICC Evaluation report for all fastener types indicating diaphragm values for metal deck gauge and substrate thickness.
   1. Coordinate fastener requirements for the different substrate thickness with the structural steel and joist suppliers.
   2. Submit certified roof fastener layout shop drawings clearly showing fastener types, layout, and installation requirements.
   3. Provide training as required by the installing contractor and Owner’s testing laboratory to assure proper installation.
   4. Owner’s testing laboratory will inspect the work in accordance with Field Quality Control requirements specified in this Section in addition to field verifying substrate thickness of beam flanges and joist top chords, and fastener type.

2.05 ACCESSORIES

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 (4.8-mm) minimum diameter.

D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi (230 MPa), not less than 0.0359-inch (0.91-mm) design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

F. Recessed Sump Pans: Single-piece steel sheet, 0.0747 inch (1.90 mm) thick, of same material and finish as deck, with 3-inch- (76-mm-) wide flanges and level recessed pans of 1-1/2-inch (38-mm) minimum depth. For drains, cut holes in the field.

G. Flat Sump Plate: Single-piece steel sheet, 0.0747 inch (1.90 mm) thick, of same material and finish as deck. For drains, cut holes in the field.

H. Galvanizing Repair Paint: ASTM A780/A780M, SSPC-Paint 20 or DOD-P-21035, with dry film containing a minimum of 94 percent zinc dust by weight.

I. See Specification Section 05 12 00 for steel headed studs.

J. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

3.02 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 30, manufacturer's written instructions, and requirements in this Section.

B. Install decking and accessories as noted in deck shop drawings, including shortened deck widths arranged to minimize cutting deck and using fillers at structural steel girders.

C. Install temporary shoring before placing deck panels, if required to meet deflection or strength limitations.

D. Locate deck bundles to prevent overloading of supporting members.

E. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
   1. Align cellular deck panels over full length of cell runs and align cells at ends of abutting panels.

F. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

G. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

H. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

I. Comply with AWS D1.1/D1.1M requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

J. Immediately after welding deck in place, touch-up welds, burned areas, and surface coating damage with prime paint.

K. Additional Composite deck requirements:
   1. Install side lap fasteners 12”oc maximum, or as indicated in Drawings, whichever is more stringent.
   2. Confirm that all plies are in contact upon fastening.
   3. Openings in bare deck shall be reinforced.
   4. Coring of deck to occur only after concrete is placed and has reached 75% of design strength.
   5. Deck installer to follow reviewed shop drawings with respect to layout, fillers, and fastening, including the strategy of starting bays with special sized deck width so low flute lands on an interior girder.
   6. Ensure sufficient deck end bearing length (SDI minimum or greater) and side bearing width (for fasteners).
   7. Do not scorch top flute of deck when installing headed studs. Damaged deck shall be replaced.
   8. Do not use a hammer to stretch side margins of deck to reach supports. Where deck does not reach supports, the contractor shall submit proposed solution for review to the Engineer for approval.
   9. Provide 3-span, minimum. Where 3-span conditions cannot be met, or framing configuration does not permit 3-span condition, increase deck gauge as necessary to enable unshored construction.

10. Contractor may shore deck at their discretion. Shoring shall be beam-to-beam and may not be supported from floor(s) below.

3.03 DECK INSTALLATION

A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches (38 mm) long, and as follows:
   1. Weld Diameter: 5/8 inch (16 mm)
   2. Weld Spacing: Weld edge and interior ribs of deck units with a minimum of one welds per deck unit at each support, unless noted otherwise on drawings.

B. Shear Studs:
   1. A welded headed stud may take the place of a puddle weld at composite deck.
   2. Weld studs through a singly ply of deck, placing studs directly over beam web.
   3. Use ferrules developed for weld-through technique. Remove after welding.

C. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports as indicated.
   1. Roof Deck - Mechanically fasten with self-drilling, No. 10 (4.8-mm-) diameter or larger, carbon-steel TEK screws.
   2. Composite and Form Deck - Mechanically fasten by button punching at 12” oc ,or with self-drilling No. 10 diameter or larger, carbon-steel TEK screws at 12” oc, unless noted otherwise on structural drawings.

D. Install deck ends over supports with bearing lengths as follows:
   1. Roof Deck (B, N):
      a. End bearing: 2"
      b. Interior bearing: 3"
   2. Floor Deck (Composite):
      a. End bearing on steel: 2"
      b. Interior bearing on steel: 4"
      c. End or interior on bare concrete or masonry supports: 4"

E. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and mechanically fasten flanges to top of deck. Space mechanical fasteners not more than 12 inches (305 mm) apart with at least one fastener at each corner.
   1. Fasten metal roof deck at 6” oc at deck opening framing.
   2. Install reinforcing channels or zees in ribs to span between supports and mechanically fasten.

F. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld or mechanically fasten to substrate to provide a complete deck installation.
   1. Fasten cover plates at changes in direction of roof-deck panels, unless otherwise indicated.

G. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

H. Sound-Absorbing Insulation: Installation into topside ribs of deck per manufacturer’s recommendations.

3.04 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field welds will be subject to inspection.

C. Testing agency will report inspection results promptly and in writing to Contractor and Architect.

D. Remove and replace work that does not comply with specified requirements.

E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.05 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.

B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.
   1. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.
   2. Wire brushing, cleaning, and repair painting of bottom deck surfaces are included in Division 9 Section 09 91 00 - Painting.

C. Repair Painting: Wire brushing, cleaning, and repair painting of rust spots, welds, and abraded areas of both deck surfaces are included in Division 9 Section 09 91 00 - Painting.

D. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION

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SECTION 05 4000
COLD-FORMED METAL FRAMING

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes the following:
   1. Exterior Cold-Formed Metal framing.

1.02 RELATED SECTIONS

A. Section 01 31 00 - Project Management and Coordination.

B. Section 01 33 00 - Submittal Procedures.

C. Section 01 40 00 - Quality Requirements.

D. Section 01 45 33 - Code-Required Special Inspections and Procedures.

E. Section 01 60 00 - Product Requirements.

F. Section 05 12 00 - Structural Steel Framing.

G. Section 05 50 00 - Metal Fabrications.

H. Section 09 91 00 - Painting.

1.03 REFERENCE STANDARDS

A. AISI S100 “North American Specification for the Design of Cold-Formed Steel Structural Members”.

B. AISI S200 “North American Standard for Cold-Formed Steel Framing - General Provisions”.

C. AISI S201 “North American Standard for Cold-Formed Steel Framing - Product Standard”.

D. AISI S211 “North American Standard for Cold-Formed Steel Framing - Wall Stud Design”.

E. AISI S212 “North American Standard for Cold-Formed Steel Framing - Header Design”.

F. AISI S213 “North American Standard for Cold-Formed Steel Framing - Lateral Design”.

G. AISI “Code of Standard Practice for Cold-Formed Steel Structural Framing”.

H. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

I. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

J. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

K. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2020.

L. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members; 2015.

M. ASTM C1513 - Standard Specification for Steel Tapping Screws for Cold-Formed Steel Framing Connections; Current Edition.

N. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection; 2023.

O. ASTM E488/E488M - Standard Test Methods for Strength of Anchors in Concrete Elements; 2022.

P. ASTM E1190 - Standard Test Methods for Strength of Power-Actuated Fasteners Installed in Structural Members; Current edition.

Q. Other ASTM standards as specified below.

R. AWS D1.1/D1.1M Structural Welding Code - Steel

1.04 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in 01 40 00 “Quality Requirements“ to design cold-formed steel framing.

B. Structural Performance: Provide cold-formed metal framing capable of withstanding design loads within limits and under conditions indicated.
   1. Design Loads: as indicated on Structural Drawings.
   2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
      a. Exterior Wall Framing: Design wall framing to meet the following horizontal deflection conditions:
         1) Typical Conditions: 1/240 of wall height.
         2) EIFS Finishes: 1/360 of wall height.
         3) Brick Veneer: 1/360 of wall height.
         4) Stone Cladding: 1/360 of wall height.
      b. Interior Wall Framing: Horizontal deflection of 1/240 of wall height under a horizontal load of 5 pound-force per square foot.
   3. Design framing systems to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.
   4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
      a. Upward and downward movement as indicated on drawings.
      b. Design exterior non-load bearing framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

C. Cold-Formed Steel Framing, General: Design according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions."
   1. Floor and Roof systems: AISI S210.
   2. Headers: AISI S212.
   3. Wall Studs: AISI S211.
   4. Lateral Design: AISI S213.
   5. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

1.05 SUBMITTALS

A. Product Data: For each type of cold-formed metal framing product and accessory indicated.

B. Shop Drawings: Provide shop drawings prepared by cold-formed metal framing manufacturer.
   1. Show layout, spacing, sizes, thicknesses, and types of cold-formed metal framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
   2. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
   3. For cold-formed metal framing indicated to comply with design loads, include comprehensive structural analysis and detailed shop drawings, signed and sealed by the qualified professional engineer, registered in the state of the project, responsible for their preparation.
      a. Comprehensive structural analysis shall be submitted concurrently with related shop drawings.
      b. Calculation shall be organized, clear and concise and shall include table of contents and page numbers.
      c. Shop Drawings received without corresponding calculations will not be reviewed by the Engineer.
   4. Resubmittals, if necessary, shall Cloud and clearly identify revisions from previous submittals.

C. Welding certificates.

D. Qualification Data: For professional engineer.

E. Product Test Reports: From a qualified testing agency, unless otherwise stated, indicating that each of the following complies with requirements, based on evaluation of comprehensive tests for current products:

F. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.
   3. See Sections 01 33 00 and 01 60 00.

G. Perform and submit reports of Code Required Special Inspections as required in Section 01 45 33.

H. Research/Evaluation Reports: For cold-formed metal framing.

1.06 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a qualified professional engineer, registered in the state of the project, responsible for their preparation.

C. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of cold-formed metal framing that are similar to those indicated for this Project in material, design, and extent.

D. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM E329 to conduct the testing indicated.

E. Product Tests: Mill certificates or data from a qualified independent testing agency, or in-house testing with calibrated test equipment indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, ductility, and metallic-coating thickness.

F. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," and AWS D1.3, "Structural Welding Code - Sheet Steel."

G. Comply with AISI Specifications and Standards.
   1. AISI S100 “North American Specification for the Design of Cold-Formed Steel Structural Members”.
   2. AISI S200 “North American Standard for Cold-Formed Steel Framing - General Provisions”.
   3. AISI S201 “North American Standard for Cold-Formed Steel Framing - Product Standard”.
   4. AISI S211 “North American Standard for Cold-Formed Steel Framing - Wall Stud Design”.
   5. AISI S212 “North American Standard for Cold-Formed Steel Framing - Header Design”.
   6. AISI S213 “North American Standard for Cold-Formed Steel Framing - Lateral Design”.
   7. AISI “Code of Standard Practice for Cold-Formed Steel Structural Framing”.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide cold-formed metal framing by one of the following:
   1. ClarkDietrich Building Systems.
   2. The Steel Network.

3. Approved company specializing in manufacturing products specified in this section with minimum three years documented experience; current member of Steel Stud Manufacturers Association.

2.02 MATERIALS

A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.

B. Steel Sheet: ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
   1. Grade: As required by structural performance.
   2. Coating: G60 (Z180).

C. Steel Sheet for Vertical Deflection Clips: ASTM A653/A653M, structural steel, zinc coated, of grade and coating as follows:
   1. Grade: As required by structural performance.
   2. Coating: G90 (Z275).

2.03 LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges.

C. Headers and Jambs - Heavy-Duty Stud: Manufacturer's proprietary shape used to form header beams and jambs, columns or posts, of web depths indicated, unpunched, with stiffened flanges.

D. Steel Box or Back-to-Back Headers: Manufacturer's standard C-shapes used to form header beams, of web depths and flange widths indicated, punched, with stiffened flanges.

E. Steel Double-L Headers: Manufacturer's standard L-shapes used to form header beams, of web depths and flange widths indicated.

2.04 EXTERIOR NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths and flange widths indicated, punched, with stiffened flanges.

B. Minimum gauge: 18 ga.

C. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges.

D. Headers and Jambs - Heavy-Duty Stud: Manufacturer's proprietary shape used to form header beams and jambs, columns or posts, of web depths and flange widths indicated, unpunched, with stiffened flanges.

E. Steel Box or Back-to-Back Headers: Manufacturer's standard C-shapes used to form header beams, of web depths and flange widths indicated, punched, with stiffened flanges.

F. Steel Double-L Headers: Manufacturer's standard L-shapes used to form header beams, of web depths and flange widths indicated.

2.05 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from steel sheet, ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
   1. Supplementary framing.
   2. Bracing, bridging, and solid blocking.
   3. Anchor clips.
   4. Stud kickers, knee braces, and girts.

C. Deflection Track and Firestop Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thicknesses not less than indicated for studs and in width to accommodate depth of studs.

D. Slotted Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; punched with vertical slots in both legs. Studs should be positively attached to deep-leg track using vertical slots while allowing free vertical movement. Legs designed to support horizontal and lateral loads and transfer them to the primary structure. Accommodate vertical movements as indicated in drawings.

E. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal and lateral loads and transfer them to the primary structure. Install a continuous row of bridging, composed of 1-1/2 inch (38 mm) cold-formed channel secured to each stud with clip angle or Spazzer 5400, at upper-most knockout, not more than 12 inches (305 mm) from top of wall.

2.06 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A36/A36M, zinc coated by hot-dip process according to ASTM A123/A123M.

B. Torsion anchor clips: Provide where indicated on drawings:
   1. ASTM A1003/A1003M Structural Grade 50 (340) Type H, ST50H (ST340H): 50ksi (340MPa) minimum yield strength, 65ksi (450MPa) minimum tensile strength. Size as indicated on drawings.
   2. Manufacturer/Product:
      a. The Steel Network/Stiffclip.
      b. ClarkDietrich/Easyclip.

C. Vertical Deflection Clips: Manufacturer's standard clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web and capable of resisting forces imposed by the wall system.

D. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E488/E488M conducted by a qualified independent testing agency.

E. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E1190 conducted by a qualified independent testing agency.

F. Mechanical Fasteners: ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.

G. Welding Electrodes: Comply with AWS standards.

2.07 MISCELLANEOUS MATERIALS

A. Shims: Load bearing, high-density multi-monomer plastic, non-leaching.

B. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch (6.4 mm) thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Install sealer gaskets to isolate the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations.

3.03 INSTALLATION, GENERAL

A. Cold-formed metal framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed metal framing according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions" and to manufacturer's written instructions unless more stringent requirements are indicated.

C. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened.
   1. Cut framing members by sawing or shearing; do not torch cut.
   2. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
      a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
      b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.

D. Install framing members in one-piece lengths unless splice connections are indicated.

E. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

F. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.

G. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.

H. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of (1:960) and as follows:
   1. Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.04 LOAD-BEARING WALL INSTALLATION

A. Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends, and at spacing to match stud spacing.

B. Squarely seat studs against top and bottom tracks with gap not exceeding of 1/8 inch (3 mm) between the end of wall framing member and the web of track. Fasten both flanges of studs to top and bottom tracks. Space studs at 24 inches (610 mm).

C. Set studs plumb, except as needed for diagonal bracing or required for non-plumb walls or warped surfaces and similar configurations.

D. Align studs vertically where floor framing interrupts wall-framing continuity. Where studs cannot be aligned, continuously reinforce track to transfer loads.

E. Align floor and roof framing over studs. Where framing cannot be aligned, continuously reinforce track to transfer loads.

F. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure as indicated.

G. Install headers over wall openings wider than stud spacing. Locate headers above openings as indicated. Fabricate headers of compound shapes indicated or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates.
   1. Frame wall openings with not less than a double stud at each jamb of frame as indicated on Shop Drawings. Fasten jamb members together to uniformly distribute loads.

2. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full-height wall studs.

H. Install supplementary framing, blocking, and bracing in stud framing indicated to support fixtures, equipment, services, casework, heavy trim, furnishings, and similar work requiring attachment to framing.
   1. If type of supplementary support is not indicated, comply with stud manufacturer's written recommendations and industry standards in each case, considering weight or load resulting from item supported.

I. Install horizontal bridging in stud system, spaced as indicated on Shop Drawings. Fasten at each stud intersection.

J. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.05 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.

B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Spacing of studs not to exceed that indicated in drawings.

C. Set studs plumb, except as needed for diagonal bracing or required for non-plumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
   1. Install deflection tracks and anchor to building structure.
   2. Install double deep-leg deflection tracks and anchor outer track to building structure.
   3. Connect vertical deflection clips to studs and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches (1220 mm) apart. Fasten at each stud intersection.
   1. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches (305 mm) of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.
   2. Bridging: Steel channel, welded or mechanically fastened to webs of punched studs.
   3. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
   4. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.06 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Remove and replace work where test results indicate that it does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.07 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer, to ensure that cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 05 40 00
COLD-FORMED METAL FRAMING

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes the following:
   1. Exterior Cold-Formed Metal framing.

1.02 RELATED SECTIONS

A. Section 01 31 00 - Project Management and Coordination.

B. Section 01 33 00 - Submittal Procedures.

C. Section 01 40 00 - Quality Requirements.

D. Section 01 45 33 - Code-Required Special Inspections and Procedures.

E. Section 01 60 00 - Product Requirements.

F. Section 05 12 00 - Structural Steel Framing.

G. Section 05 50 00 - Metal Fabrications.

H. Section 09 91 00 - Painting.

1.03 REFERENCE STANDARDS

A. AISI S100 “North American Specification for the Design of Cold-Formed Steel Structural Members”.

B. AISI S200 “North American Standard for Cold-Formed Steel Framing - General Provisions”.

C. AISI S201 “North American Standard for Cold-Formed Steel Framing - Product Standard”.

D. AISI S211 “North American Standard for Cold-Formed Steel Framing - Wall Stud Design”.

E. AISI S212 “North American Standard for Cold-Formed Steel Framing - Header Design”.

F. AISI S213 “North American Standard for Cold-Formed Steel Framing - Lateral Design”.

G. AISI “Code of Standard Practice for Cold-Formed Steel Structural Framing”.

H. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

I. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

J. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

K. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2020.

L. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members; 2015.

M. ASTM C1513 - Standard Specification for Steel Tapping Screws for Cold-Formed Steel Framing Connections; Current Edition.

N. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection; 2023.

O. ASTM E488/E488M - Standard Test Methods for Strength of Anchors in Concrete Elements; 2022.

P. ASTM E1190 - Standard Test Methods for Strength of Power-Actuated Fasteners Installed in Structural Members; Current edition.

Q. Other ASTM standards as specified below.

R. AWS D1.1/D1.1M Structural Welding Code - Steel

1.04 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in 01 40 00 “Quality Requirements“ to design cold-formed steel framing.

B. Structural Performance: Provide cold-formed metal framing capable of withstanding design loads within limits and under conditions indicated.
   1. Design Loads: as indicated on Structural Drawings.
   2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
      a. Exterior Wall Framing: Design wall framing to meet the following horizontal deflection conditions:
         1) Typical Conditions: 1/240 of wall height.
         2) EIFS Finishes: 1/360 of wall height.
         3) Brick Veneer: 1/360 of wall height.
         4) Stone Cladding: 1/360 of wall height.
      b. Interior Wall Framing: Horizontal deflection of 1/240 of wall height under a horizontal load of 5 pound-force per square foot.
   3. Design framing systems to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.
   4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
      a. Upward and downward movement as indicated on drawings.
      b. Design exterior non-load bearing framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

C. Cold-Formed Steel Framing, General: Design according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions."
   1. Floor and Roof systems: AISI S210.
   2. Headers: AISI S212.
   3. Wall Studs: AISI S211.
   4. Lateral Design: AISI S213.
   5. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

1.05 SUBMITTALS

A. Product Data: For each type of cold-formed metal framing product and accessory indicated.

B. Shop Drawings: Provide shop drawings prepared by cold-formed metal framing manufacturer.
   1. Show layout, spacing, sizes, thicknesses, and types of cold-formed metal framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
   2. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
   3. For cold-formed metal framing indicated to comply with design loads, include comprehensive structural analysis and detailed shop drawings, signed and sealed by the qualified professional engineer, registered in the state of the project, responsible for their preparation.
      a. Comprehensive structural analysis shall be submitted concurrently with related shop drawings.
      b. Calculation shall be organized, clear and concise and shall include table of contents and page numbers.
      c. Shop Drawings received without corresponding calculations will not be reviewed by the Engineer.
   4. Resubmittals, if necessary, shall Cloud and clearly identify revisions from previous submittals.

C. Welding certificates.

D. Qualification Data: For professional engineer.

E. Product Test Reports: From a qualified testing agency, unless otherwise stated, indicating that each of the following complies with requirements, based on evaluation of comprehensive tests for current products:

F. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.
   3. See Sections 01 33 00 and 01 60 00.

G. Perform and submit reports of Code Required Special Inspections as required in Section 01 45 33.

H. Research/Evaluation Reports: For cold-formed metal framing.

1.06 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a qualified professional engineer, registered in the state of the project, responsible for their preparation.

C. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of cold-formed metal framing that are similar to those indicated for this Project in material, design, and extent.

D. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM E329 to conduct the testing indicated.

E. Product Tests: Mill certificates or data from a qualified independent testing agency, or in-house testing with calibrated test equipment indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, ductility, and metallic-coating thickness.

F. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," and AWS D1.3, "Structural Welding Code - Sheet Steel."

G. Comply with AISI Specifications and Standards.
   1. AISI S100 “North American Specification for the Design of Cold-Formed Steel Structural Members”.
   2. AISI S200 “North American Standard for Cold-Formed Steel Framing - General Provisions”.
   3. AISI S201 “North American Standard for Cold-Formed Steel Framing - Product Standard”.
   4. AISI S211 “North American Standard for Cold-Formed Steel Framing - Wall Stud Design”.
   5. AISI S212 “North American Standard for Cold-Formed Steel Framing - Header Design”.
   6. AISI S213 “North American Standard for Cold-Formed Steel Framing - Lateral Design”.
   7. AISI “Code of Standard Practice for Cold-Formed Steel Structural Framing”.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide cold-formed metal framing by one of the following:
   1. ClarkDietrich Building Systems.
   2. The Steel Network.

3. Approved company specializing in manufacturing products specified in this section with minimum three years documented experience; current member of Steel Stud Manufacturers Association.

2.02 MATERIALS

A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.

B. Steel Sheet: ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
   1. Grade: As required by structural performance.
   2. Coating: G60 (Z180).

C. Steel Sheet for Vertical Deflection Clips: ASTM A653/A653M, structural steel, zinc coated, of grade and coating as follows:
   1. Grade: As required by structural performance.
   2. Coating: G90 (Z275).

2.03 LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges.

C. Headers and Jambs - Heavy-Duty Stud: Manufacturer's proprietary shape used to form header beams and jambs, columns or posts, of web depths indicated, unpunched, with stiffened flanges.

D. Steel Box or Back-to-Back Headers: Manufacturer's standard C-shapes used to form header beams, of web depths and flange widths indicated, punched, with stiffened flanges.

E. Steel Double-L Headers: Manufacturer's standard L-shapes used to form header beams, of web depths and flange widths indicated.

2.04 EXTERIOR NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths and flange widths indicated, punched, with stiffened flanges.

B. Minimum gauge: 18 ga.

C. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges.

D. Headers and Jambs - Heavy-Duty Stud: Manufacturer's proprietary shape used to form header beams and jambs, columns or posts, of web depths and flange widths indicated, unpunched, with stiffened flanges.

E. Steel Box or Back-to-Back Headers: Manufacturer's standard C-shapes used to form header beams, of web depths and flange widths indicated, punched, with stiffened flanges.

F. Steel Double-L Headers: Manufacturer's standard L-shapes used to form header beams, of web depths and flange widths indicated.

2.05 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from steel sheet, ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
   1. Supplementary framing.
   2. Bracing, bridging, and solid blocking.
   3. Anchor clips.
   4. Stud kickers, knee braces, and girts.

C. Deflection Track and Firestop Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thicknesses not less than indicated for studs and in width to accommodate depth of studs.

D. Slotted Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; punched with vertical slots in both legs. Studs should be positively attached to deep-leg track using vertical slots while allowing free vertical movement. Legs designed to support horizontal and lateral loads and transfer them to the primary structure. Accommodate vertical movements as indicated in drawings.

E. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal and lateral loads and transfer them to the primary structure. Install a continuous row of bridging, composed of 1-1/2 inch (38 mm) cold-formed channel secured to each stud with clip angle or Spazzer 5400, at upper-most knockout, not more than 12 inches (305 mm) from top of wall.

2.06 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A36/A36M, zinc coated by hot-dip process according to ASTM A123/A123M.

B. Torsion anchor clips: Provide where indicated on drawings:
   1. ASTM A1003/A1003M Structural Grade 50 (340) Type H, ST50H (ST340H): 50ksi (340MPa) minimum yield strength, 65ksi (450MPa) minimum tensile strength. Size as indicated on drawings.
   2. Manufacturer/Product:
      a. The Steel Network/Stiffclip.
      b. ClarkDietrich/Easyclip.

C. Vertical Deflection Clips: Manufacturer's standard clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web and capable of resisting forces imposed by the wall system.

D. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E488/E488M conducted by a qualified independent testing agency.

E. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E1190 conducted by a qualified independent testing agency.

F. Mechanical Fasteners: ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.

G. Welding Electrodes: Comply with AWS standards.

2.07 MISCELLANEOUS MATERIALS

A. Shims: Load bearing, high-density multi-monomer plastic, non-leaching.

B. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch (6.4 mm) thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Install sealer gaskets to isolate the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations.

3.03 INSTALLATION, GENERAL

A. Cold-formed metal framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed metal framing according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions" and to manufacturer's written instructions unless more stringent requirements are indicated.

C. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened.
   1. Cut framing members by sawing or shearing; do not torch cut.
   2. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
      a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
      b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.

D. Install framing members in one-piece lengths unless splice connections are indicated.

E. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

F. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.

G. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.

H. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of (1:960) and as follows:
   1. Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.04 LOAD-BEARING WALL INSTALLATION

A. Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends, and at spacing to match stud spacing.

B. Squarely seat studs against top and bottom tracks with gap not exceeding of 1/8 inch (3 mm) between the end of wall framing member and the web of track. Fasten both flanges of studs to top and bottom tracks. Space studs at 24 inches (610 mm).

C. Set studs plumb, except as needed for diagonal bracing or required for non-plumb walls or warped surfaces and similar configurations.

D. Align studs vertically where floor framing interrupts wall-framing continuity. Where studs cannot be aligned, continuously reinforce track to transfer loads.

E. Align floor and roof framing over studs. Where framing cannot be aligned, continuously reinforce track to transfer loads.

F. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure as indicated.

G. Install headers over wall openings wider than stud spacing. Locate headers above openings as indicated. Fabricate headers of compound shapes indicated or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates.
   1. Frame wall openings with not less than a double stud at each jamb of frame as indicated on Shop Drawings. Fasten jamb members together to uniformly distribute loads.

2. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full-height wall studs.

H. Install supplementary framing, blocking, and bracing in stud framing indicated to support fixtures, equipment, services, casework, heavy trim, furnishings, and similar work requiring attachment to framing.
   1. If type of supplementary support is not indicated, comply with stud manufacturer's written recommendations and industry standards in each case, considering weight or load resulting from item supported.

I. Install horizontal bridging in stud system, spaced as indicated on Shop Drawings. Fasten at each stud intersection.

J. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.05 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.

B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Spacing of studs not to exceed that indicated in drawings.

C. Set studs plumb, except as needed for diagonal bracing or required for non-plumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
   1. Install deflection tracks and anchor to building structure.
   2. Install double deep-leg deflection tracks and anchor outer track to building structure.
   3. Connect vertical deflection clips to studs and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches (1220 mm) apart. Fasten at each stud intersection.
   1. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches (305 mm) of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.
   2. Bridging: Steel channel, welded or mechanically fastened to webs of punched studs.
   3. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
   4. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.06 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Remove and replace work where test results indicate that it does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.07 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer, to ensure that cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 05 5000
METAL FABRICATIONS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:
   1. Ferrous Metals.
   2. Non-Ferrous Metals.
   3. Fasteners.
   4. Miscellaneous Materials.
   5. Miscellaneous Framing and supports:
      a. Steel framing and supports for overhead divider nets.
      b. Steel framing and supports for countertops.
      c. Steel framing and supports for mechanical and electrical equipment.
      d. Steel framing for equipment platforms.
      e. Steel framing and supports for trellises.
      f. Steel framing and supports for Bistro.
      g. Elevator machine beams and hoist beams.
      h. Steel shapes for supporting elevator door sills.
   6. Metal ladders.
   7. Metal guardrail.
   8. Metal ships' ladders.
   9. Metal bollards.
   10. Fixed and loose steel lintels.

B. Products furnished, but not installed, under this Section:
   1. Loose steel lintels.
   2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
   3. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

1.03 RELATED SECTIONS:

A. Section 01 31 00 - Project Management and Coordination.

B. Section 01 31 00.05 - Project BIM Coordination.

C. Section 01 33 00 - Submittal Procedures.

D. Section 01 40 00 - Quality Requirements.

E. Section 01 60 00 - Product Requirements.

F. Section 03 30 00 - Cast-in-Place Concrete.

G. Section 04 20 00 - Unit Masonry Assemblies.

H. Section 05 51 00 - Metal Stairs.

I. Section 05 73 13 - Glazed Decorative Railings.

1.04 REFERENCE STANDARDS

A. AISC 360 Specification for Structural Steel Buildings.

B. ASCE/SEI 7 Minimum Design Loads For Buildings and Other Structures.

C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

D. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.

E. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

F. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.

G. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2023.

H. ASTM A563/A563M - Standard Specification for Carbon and Alloy Steel Nuts (Inch and Metric); 2021a.

I. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

J. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2020.

K. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2023, with Editorial Revision.

L. ASTM B26/B26M - Standard Specification for Aluminum-Alloy Sand Castings; 2018, with Editorial Revision.

M. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.

N. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

O. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.

P. ASTM B632/B632M - Standard Specification for Aluminum-Alloy Rolled Tread Plate; 2018.

Q. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.

R. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2020.

S. ASTM E488/E488M - Standard Test Methods for Strength of Anchors in Concrete Elements; 2022.

T. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength; 2020.

U. ASTM F1941/F1941M - Standard Specification for Electrodeposited Coatings on Mechanical Fasteners, Inch and Metric; 2016.

V. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).

W. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).

X. AWS D1.6/D1.6M - Structural Welding Code - Stainless Steel; 2017, with Amendment (2021).

Y. MFMA-4 - Metal Framing Standards Publication; 2004.

Z. NAAMM AMP 500-06 - Metal Finishes Manual; 2006.

AA. NACE No. 3 - Joint Surface Preparation Standard Commercial Blast Cleaning; 1994 (Reaffirmed 2006).

BB. SSPC-PA 1 - Shop, Field, and Maintenance Coating of Metals; 2024.

CC. SSPC-SP 3 - Power Tool Cleaning; 2024.

DD. SSPC-SP 6 - Commercial Blast Cleaning; 2007.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Work Completed under this section must be coordinated with other work using BIM modelling. See Section 01 31 00.05 for requirements.

1.06 SUBMITTALS

A. Submit BIM models as required by Section 01 31 00.05.

B. Shop Drawings: Show fabrication and installation details for metal fabrications.
   1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
   2. Shop Drawing submittals must conform with coordinated BIM models. See Section 01 31 00.05.

C. Samples for Verification: For each type and finish of extruded nosing and tread.

D. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   1. Calculation shall be organized, clear and concise and shall include table of contents and page numbers.
   2. Calculations shall be submitted concurrently with shop/erection drawings and shall be signed and sealed at time of submission.
   3. Changes from Construction documents:
      a. Cloud and clearly identify all changes or deviations from the construction documents.

E. Qualification Data: For qualified professional engineer.

F. Welding certificates.

G. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

H. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.
   3. See Sections 01 33 00 and 01 60 00.

1.07 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Welding Qualifications: Qualify procedures and personnel according to the following:
   1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
   2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
   3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.08 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

1.09 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages and steel weld plates and angles for casting into concrete. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 PRODUCTS

2.01 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.02 FERROUS METALS

A. Recycled Content of Steel Products: Provide products with average recycled content of steel products so post-consumer recycled content plus one-half of pre-consumer recycled content is not less than 25 percent.

B. WIDE FLANGE SHAPES, CHANNELS, AND WT SHAPES: ASTM A992 (Fy = 50 ksi).

C. OTHER SHAPES, PLATES, ANGLES, AND BARS: ASTM A572 (Fy = 50 ksi) (UNO)

D. HOLLOW STRUCTURAL SECTIONS (HSS): ASTM A500/A500M, GRADE C (Fy = 50 ksi)

E. Steel Pipe: ASTM A53/A53M, standard weight (Schedule 40) unless otherwise indicated.

F. STAINLESS STEEL SHAPES AND PLATES: ASTM 304

G. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.
   1. Size of Channels: 1-5/8 by 1-5/8 inches (41 by 41 mm).
   2. Material: Galvanized steel, ASTM A653/A653M, commercial steel, Type B, with G90 (Z275) coating; 0.108-inch (2.8-mm) nominal thickness.
   3. Material: Cold-rolled steel, ASTM A1008/A1008M, commercial steel, Type B; 0.0966-inch (2.5-mm) minimum thickness; unfinished.

2.03 NONFERROUS METALS

A. Aluminum Plate and Sheet: ASTM B209/B209M, Alloy 6061-T6.

B. Aluminum Extrusions: ASTM B221 (ASTM B221M), Alloy 6063-T6.

C. Aluminum-Alloy Rolled Tread Plate: ASTM B632/B632M, Alloy 6061-T6.

D. Aluminum Castings: ASTM B26/B26M, Alloy 443.0-F.

2.04 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F3125/F3125M, Class Fe/Zn 5, at exterior. Select fasteners for type, grade, and class required.

B. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563/A563M; and, where indicated, flat washers.

C. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.

2.05 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
   1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

D. Non-shrink, Metallic Grout: Factory-packaged, ferrous-aggregate grout complying with ASTM C1107/C1107M, specifically recommended by manufacturer for heavy-duty loading applications.

E. Concrete: Comply with requirements in Division 3 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi (20 MPa).

2.06 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
   1. Fabricate units from slotted channel framing where indicated.
   2. Furnish inserts for units installed after concrete is placed.

C. Prime miscellaneous framing and supports with universal shop primer unless noted otherwise.

D. Galvanize and prime miscellaneous framing and supports with universal shop primer where indicated on drawings.

E. Counter/Bench Mounting brackets: See drawings for locations.
   1. Custom Steel tube or angle brackets:
      a. See drawings for size and location.
   2. Prefabricated Steel Brackets: Low profile, concealed counter brackets
      a. Manufacturer and Product:
         1) FastCap; Stealth SpeedBrace.
         2) Or approved equal.
      b. Pair of brackets must support min 300 lbs.
      c. Size as indicated on drawings and as recommended by Manufacturer for the application.
   3. Sauna Bench hardware: See detail.
      a. 6x6 12 ga galv bracket.
         1) Simpson A66
         2) or Equal.
      b. 2 1/2 x 1 1/2" 18 ga clip
         1) Simpson A23
         2) or Equal.

2.07 METAL SHIPS' LADDERS

A. Provide metal ships' ladders where indicated. Contractor's option: Provide Steel ladder or Prefabricated Aluminum ladder.
   1. Steel Ladder:
      a. Fabricate of open-type construction with channel or plate stringers and pipe and tube railings unless otherwise indicated. Provide brackets and fittings for installation.
         1) Fabricate ships' ladders, including railings from steel.
         2) Treads and platforms: Contractor's option:
            (a) Fabricate treads and platforms from welded or pressure-locked steel bar grating. Limit openings in gratings to no more than 1/2 inch (12 mm) in least dimension.
            (b) Fabricate treads and platforms from rolled-steel floor plate.
         3) Comply with applicable railing requirements in Section 05 51 00 - Metal Stairs.
      b. Prime steel ships' ladders, including treads, railings, brackets, and fasteners, with universal shop primer.
   2. Prefabricated Aluminum Ladder:
      a. Provide Prefabricated, open type aluminum ladders with channel stringers and pipe and tube railings unless otherwise indicated. Provide brackets and fittings for installation.
         1) Prefabricated Ladder shall include all components necessary for installation.
            (a) Provide galvanic protection between aluminum and incompatible metals as necessary.
         2) Treads and Platforms: Treads and platforms shall consist of serrated aluminum channels for maximum traction.
         3) Handrails shall comply with applicable requirements of Section 05 51 00 - Metal Stairs.
            (a) Railings shall be min 1 1/4" Sch 40 Aluminum pipe.

2.08 METAL BOLLARDS

A. Fabricate metal bollards from Schedule 40 steel pipe 1/4-inch (6.4-mm) wall-thickness rectangular steel tubing steel shapes, as indicated.

B. Fabricate sleeves for bollard anchorage from steel pipe with 1/4-inch- (6.4-mm-) thick steel plate welded to bottom of sleeve. Make sleeves not less than 8 inches (200 mm) deep and 3/4 inch (19 mm) larger than OD of bollard.

C. Fabricate internal sleeves for removable bollards from Schedule 40 steel pipe or 1/4-inch (6.4-mm) wall-thickness steel tubing with an OD approximately 1/16 inch (1.5 mm) less than ID of bollards. Match drill sleeve and bollard for 3/4 inch (19 mm) steel machine bolt.

D. See drawings for height and diameter.

E. Prime bollards with universal shop primer.

2.09 FIXED AND LOOSE STEEL LINTELS

A. Fabricate fixed and loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.

B. Loose lintels shall be sized to provide sufficient bearing length as noted in Drawings

C. Galvanize and prime with universal shop primer fixed and loose steel lintels located in exterior walls and where indicated on drawings.

D. Prime fixed and loose steel lintels with universal shop primer unless noted otherwise.

2.10 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

2.11 FINISHES, GENERAL

A. Comply with NAAMM AMP 500-06 "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish metal fabrications after assembly.

C. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.12 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.
   1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

C. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:
   1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
   2. Other Items: SSPC-SP 3, "Power Tool Cleaning."

D. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

2.13 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. As-Fabricated Finish: AA-M10 (Mechanical Finish: as fabricated, unspecified).

PART 3 EXECUTION

3.01 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
   1. Cast Aluminum: Heavy coat of bituminous paint.
   2. Extruded Aluminum: Two coats of clear lacquer.

3.02 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

B. Anchor supports for operable partitions securely to and rigidly brace from building structure.

C. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.
   1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.

D. Install pipe columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified in "Installing Bearing and Leveling Plates" Article.
   1. Grout baseplates of columns supporting steel girders after girders are installed and leveled.

3.03 INSTALLING METAL BOLLARDS

A. Anchor bollards in concrete. Fill annular space around bollard solidly with nonshrink, nonmetallic grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch (3 mm) toward bollard.

B. Fill bollards solidly with concrete, mounding top surface to shed water.

3.04 INSTALLING BEARING AND LEVELING PLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.

B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.
   1. Use non-shrink grout, either metallic or non-metallic, in concealed locations where not exposed to moisture; use non-shrink, non-metallic grout in exposed locations unless otherwise indicated.
   2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.05 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION

SECTION 05 5100
METAL STAIRS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Industrial-type stairs with steel floor plate treads.
   2. Industrial-type stairs with steel bar grate treads.
   3. Ornamental steel-framed stairs.
   4. Steel tube railings attached to stairs or ramps.
   5. Steel tube handrails attached to walls adjacent to stairs or ramps.

1.02 RELATED SECTIONS

A. Section 01 31 00 - Project Management and Coordination.

B. Section 01 31 00.05 - Project BIM Coordination.

C. Section 01 33 00 - Submittal Procedures.

D. Section 01 40 00 - Quality Requirements.

E. Section 01 60 00 - Product Requirements.

F. Section 03 20 00 - Concrete Reinforcement.

G. Section 03 30 00 - Cast-in-Place Concrete.

H. Section 04 20 00 - Unit Masonry Assemblies.

I. Section 05 50 00 - Metal Fabrications.

J. Section 05 73 13 - Glazed Decorative Metal Railings.

K. Section 05 77 30 - Smoke Baffle Systems.

L. Section 06 10 00 - Rough Carpentry.

M. Section 09 30 00 - Tile.

N. Section 09 91 00 - Painting.

1.03 REFERENCE STANDARDS

A. AISC 303 Code of Standard Practice for Steel Buildings and Bridges.

B. AISC 360 Specification for Structural Steel Buildings.

C. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

E. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.

F. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2018.

G. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2023.

H. ASTM A510/A510M - Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel, and Alloy Steel; 2020.

I. ASTM A513/A513M - Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing; 2020a.

J. ASTM A572/A572M - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel; 2021, with Editorial Revision.

K. ASTM A786/A786M - Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates; 2015 (Reapproved 2021).

L. ASTM A992/A992M - Standard Specification for Structural Steel Shapes; 2022.

M. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.

N. ASTM A1018A/A1018M - Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Carbon, Commercial, Drawing, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; Current Edition.

O. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.

P. ASTM F1267 - Standard Specification for Metal, Expanded, Steel; 2018 (Reapproved 2023).

Q. ASTM F1941/F1941M - Standard Specification for Electrodeposited Coatings on Mechanical Fasteners, Inch and Metric; 2016.

R. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).

S. NAAMM AMP 500-06 - Metal Finishes Manual; 2006.

T. NAAMM AMP 510 - Metal Stairs Manual; 1992.

U. NAAMM MBG 531 - Metal Bar Grating Manual; 2024.

V. SDI (DM) - Publication No.30, Design Manual for Composite Decks, Form Decks, and Roof Decks; 2007.

W. SSPC-PA 1 - Shop, Field, and Maintenance Coating of Metals; 2024.

X. SSPC-SP 3 - Power Tool Cleaning; 2024.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Work Completed under this section must be coordinated with other work using BIM modelling. See Section 01 31 00.05 for requirements.

1.05 PERFORMANCE REQUIREMENTS

A. Design stairs and components, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads including finishes and the following loads and stresses within limits and under conditions indicated.
   1. Uniform Live Load: 100 lbf/sq. ft. (4.79 kN/sq. m).
   2. Concentrated Live Load: 300 lbf (1.33 kN) applied on an area of 4 sq. in. (2580 sq. mm).
   3. Uniform and concentrated loads need not be assumed to act concurrently.
   4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
   5. Limit deflection of treads, platforms, and framing members to L/240 or 1/4 inch (6.4 mm), whichever is less.

C. Structural Performance of Railings: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.
   1. Handrails and Top Rails of Guards:
      a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
      b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
      c. Uniform and concentrated loads need not be assumed to act concurrently.
   2. Infill of Guards:
      a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
      b. Infill load and other loads need not be assumed to act concurrently.

D. Seismic Performance: Metal stairs shall withstand the effects of earthquake motions determined according to ASCE 7/SEI 7.

1. Component Importance Factor is 1.25.

1.06 SUBMITTALS

A. Product Data: For metal stairs.

B. Submit BIM models as required by Section 01 31 00.05.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
   2. Shop Drawing submittals must conform with coordinated BIM models. See Section 01 31 00.05.
   3. Fabricator is responsible for designing and detailing all connections to supporting structures, including embedded items. All applied loads from the stairs to the support structure shall be clearly defined within the shop drawings.
   4. Include embedment drawings.
   5. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
   6. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.
   7. For stairs and components indicated to comply with design loads, include comprehensive structural analysis design data signed and sealed by qualified professional engineer, registered in the state of the project, responsible for their preparation.
      a. Calculation shall be organized, clear and concise and shall include table of contents and page numbers.
      b. Calculations shall be submitted concurrently with shop/erection drawings and shall be signed and sealed at time of submission.
      c. Shop Drawings received without corresponding calculations will not be reviewed by the Engineer.
   8. Resubmittals, if necessary, shall cloud and clearly identify revisions from previous submittals.

D. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.
   3. See Sections 01 33 00 and 01 60 00.

1.07 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Installer Qualifications: Fabricator of products.

C. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," for class of stair designated, unless more stringent requirements are indicated.
   1. Industrial-Type Stairs: Industrial class.
   2. Ornamental Stairs: Architectural class.

D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.08 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for metal stairs. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

C. Coordinate locations of hanger rods and struts with other work so that they will not encroach on required stair width and will be within the fire-resistance-rated stair enclosure.

PART 2 PRODUCTS

2.01 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.02 FERROUS METALS

A. Recycled Content of Steel Products: Provide products with average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.

B. General: Comply with the following: ASTM A572/A572M, ASTM A992/A992M.

C. Steel Plates, Shapes, and Bars: ASTM A36/A36M, ASTM A53/A53M.

D. Steel Tubing: ASTM A500/A500M (cold formed) or ASTM A513/A513M.

E. Rolled-Steel Floor Plate: SDI (DM), ASTM A786/A786M, rolled from plate complying with ASTM A36/A36M or ASTM A283/A283M, Grade C or D.

F. Steel Bars for Grating Treads: ASTM A36/A36M or steel strip, ASTM A1011/A1011M or ASTM A1018A/A1018M.

G. Wire Rod for Grating Crossbars: ASTM A510/A510M.

H. Uncoated, Hot-Rolled Steel Sheet: ASTM A1011/A1011M, either commercial steel, Type B, or structural steel, Grade 30 (Grade 205), unless another grade is required by design loads.

I. Expanded-Metal, Carbon Steel: ASTM F1267, Type I (expanded), Class 1 (uncoated).

J. Woven-Wire Mesh: Intermediate-crimp, diamond pattern, 2-inch (50-mm) woven-wire mesh, made from 0.135-inch (3.5-mm) nominal diameter wire complying with ASTM A510/A510M.

2.03 FASTENERS

A. General: Provide zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required.

2.04 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Shop Primers: Provide primers that comply with Division 9 painting Sections.

C. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
   1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

D. Concrete Materials and Properties: Comply with requirements in Division 3 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3,000 psi (20 MPa) unless otherwise indicated.

2.05 FABRICATION, GENERAL

A. Provide complete stair assemblies, including metal framing, hangers, struts, railings, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure. All components to comply with NAAMM AMP 510.
   1. Join components by welding unless otherwise indicated.
   2. Use connections that maintain structural value of joined pieces.
   3. Fabricate treads and platforms of exterior stairs so finished walking surfaces slope to drain.

B. Preassembled Stairs: Assemble stairs in shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

E. Form exposed work with accurate angles and surfaces and straight edges.

F. Weld connections to comply with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. Weld exposed corners and seams continuously unless otherwise indicated.
   5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 3 welds: partially dressed weld with spatter removed.

G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated. Locate joints where least conspicuous.

H. Fabricate joints that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

2.06 STEEL-FRAMED STAIRS

A. Stair Framing:
   1. Fabricate stringers of steel channels or tubes as indicated in Drawings.
      a. Provide closures for exposed ends of tube stringers.
   2. Construct platforms of steel channel or tube headers and miscellaneous framing members as indicated.
   3. Weld or bolt stringers to headers; weld or bolt framing members to stringers and headers. If using bolts, fabricate and join so bolts are not exposed on finished surfaces.
   4. Where stairs are enclosed by gypsum board assemblies, provide hanger rods or struts to support landings above or below. Locate hanger rods and struts where they will not encroach on required stair width and will be within the fire-resistance-rated stair enclosure.
      a. Hangers from construction above permitted only as indicated in Drawings. Coordinate all support conditions with Architect and Engineer.
   5. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.

B. Metal-Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness indicated.
   1. Steel Sheet: Uncoated hot-rolled steel sheet.
   2. Steel Sheet: Galvanized-steel sheet, where indicated.
   3. Directly weld metal pans to stringers; locate welds on top of subtreads where they will be concealed by concrete fill. Do not weld risers to stringers.
   4. Attach risers and subtreads to stringers with brackets made of steel angles or bars. Weld brackets to stringers and attach metal pans to brackets by welding, riveting, or bolting.

C. Metal Floor Plate Stairs: Form treads and platforms to configurations shown from checkered rolled-steel floor plate of thickness needed to comply with performance requirements, but not less than 1/8 inch (3.2 mm).
   1. Form treads with integral nosing and back edge stiffener. Form risers of same material as treads.
   2. Weld steel supporting brackets to stringers and weld treads to brackets.
   3. Fabricate platforms with integral nosings matching treads and weld to platform framing.

D. Metal Bar-Grating Stairs: Form treads and platforms to configurations shown from metal bar grating; fabricate to comply with NAAMM MBG 531, "Metal Bar Grating Manual."

1. Fabricate treads and platforms from welded or pressure-locked steel grating with 1-by-1/8-inch (25-by-3-mm) bearing bars at 7/16 inch (11 mm) o.c. and crossbars at 4 inches (100 mm) o.c.
2. Fabricate treads and platforms from welded or pressure-locked steel grating with openings in gratings no more than 5/16 inch (8 mm) in least dimension.
3. Surface: Serrated.
4. Finish: Shop primed.
5. Fabricate grating treads with rolled-steel floor plate nosing and with steel angle or steel plate carrier at each end for stringer connections. Secure treads to stringers with bolts.
6. Fabricate grating platforms with nosing matching that on grating treads. Provide toeplates at open-sided edges of grating platforms. Weld grating to platform framing.

2.07 RAILINGS

A. Comply with applicable requirements in Section 05 73 13 - Glazed Decorative Metal Railings.
   1. Rails may be bent at corners, rail returns, and wall returns, instead of using prefabricated fittings.
   2. Connect posts to stair framing by direct welding unless otherwise indicated.

B. Steel Tube Railings: Fabricate railings to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of tube, post spacings, and anchorage, but not less than that needed to withstand indicated loads.
   1. Rails and Posts: 1-5/8-inch- (41-mm-) diameter top and bottom rails.
   2. Picket Infill: Minimum of 1/2-inch- (13-mm-) pickets spaced less than 4 inches (100 mm) clear.
   3. Mesh Infill: Woven wire mesh crimped into 1-by-1/2-by-1/8-inch (25-by-13-by-3-mm) steel channel frames. Orient wire mesh with diamonds vertical.
   4. Gates: Form gates from steel tube of same size and shape as top rails, with infill to match guards. Provide with cam-type, self-closing hinges for fastening to wall and overlapping stop with rubber bumper to prevent gate from opening in direction opposite egress.

C. Welded Connections: Fabricate railings with welded connections. Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
   1. Finish welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 3 welds: partially dressed weld with spatter removed.

D. Form changes in direction of railings as follows:
   1. As detailed.
   2. By bending or by inserting prefabricated elbow fittings.

E. Close exposed ends of railing members with prefabricated end fittings.

F. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.

G. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and for attaching to other work. Furnish inserts and other anchorage devices for connecting to concrete or masonry work.
   1. Connect posts to stair framing by direct welding unless otherwise indicated.
   2. For galvanized railings, provide galvanized fittings, brackets, fasteners, sleeves, and other ferrous-metal components.
   3. For nongalvanized railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors embedded in exterior masonry and concrete construction.

H. Fillers: Provide fillers made from steel plate, or other suitably crush-resistant material, where needed to transfer wall bracket loads through wall finishes to structural supports. Size fillers to suit wall finish thicknesses and to produce adequate bearing area to prevent bracket rotation and overstressing of substrate.

2.08 FINISHES

A. Comply with NAAMM AMP 500-06 "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish metal stairs after assembly.

C. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed products:
   1. Interior Stairs: SSPC-SP 3, "Power Tool Cleaning."

D. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
   1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

E. See Spec Section 09 91 00 for final paint finish.

PART 3 EXECUTION

3.01 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
   1. Coordinate all required anchorage / fastening conditions with General Contractor prior to construction.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.

C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.

D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

E. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

F. Field Welding: Comply with requirements for welding in "Fabrication, General" Article.

G. Place and finish concrete fill for treads and platforms to comply with Section 03 30 00 - Cast-in-Place Concrete.

3.02 INSTALLING METAL STAIRS WITH GROUTED BASEPLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of baseplates.

B. Set steel stair baseplates on wedges, shims, or leveling nuts. After stairs have been positioned and aligned, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.
   1. Use nonmetallic, nonshrink grout unless otherwise indicated.
   2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.03 INSTALLING RAILINGS

A. Adjust railing systems before anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated or, if not indicated, as required by design loads. Plumb posts in each direction. Secure posts and rail ends to building construction as follows:
   1. Anchor posts to steel by welding directly to steel supporting members.
   2. Anchor handrail ends to concrete and masonry with steel round flanges welded to rail ends and anchored with postinstalled anchors and bolts.

B. Attach handrails to wall with wall brackets. Use type of bracket with predrilled hole for exposed bolt anchorage. Provide bracket with 1-1/2-inch (38-mm) clearance from inside face of handrail and

finished wall surface. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads. Secure wall brackets to building construction as follows:

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
2. For hollow masonry anchorage, use toggle bolts.
3. For steel-framed partitions, use hanger or lag bolts set into fire-retardant-treated wood backing between studs. Coordinate with stud installation to locate backing members.

3.04 ADJUSTING AND CLEANING

A. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 9 painting Sections.

END OF SECTION

SECTION 05 51 00
METAL STAIRS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Industrial-type stairs with steel floor plate treads.
   2. Industrial-type stairs with steel bar grate treads.
   3. Ornamental steel-framed stairs.
   4. Steel tube railings attached to stairs or ramps.
   5. Steel tube handrails attached to walls adjacent to stairs or ramps.

1.02 RELATED SECTIONS

A. Section 01 31 00 - Project Management and Coordination.

B. Section 01 31 00.05 - Project BIM Coordination.

C. Section 01 33 00 - Submittal Procedures.

D. Section 01 40 00 - Quality Requirements.

E. Section 01 60 00 - Product Requirements.

F. Section 03 20 00 - Concrete Reinforcement.

G. Section 03 30 00 - Cast-in-Place Concrete.

H. Section 04 20 00 - Unit Masonry Assemblies.

I. Section 05 50 00 - Metal Fabrications.

J. Section 05 73 13 - Glazed Decorative Metal Railings.

K. Section 05 77 30 - Smoke Baffle Systems.

L. Section 06 10 00 - Rough Carpentry.

M. Section 09 30 00 - Tile.

N. Section 09 91 00 - Painting.

1.03 REFERENCE STANDARDS

A. AISC 303 Code of Standard Practice for Steel Buildings and Bridges.

B. AISC 360 Specification for Structural Steel Buildings.

C. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

E. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.

F. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2018.

G. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2023.

H. ASTM A510/A510M - Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel, and Alloy Steel; 2020.

I. ASTM A513/A513M - Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing; 2020a.

J. ASTM A572/A572M - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel; 2021, with Editorial Revision.

K. ASTM A786/A786M - Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates; 2015 (Reapproved 2021).

L. ASTM A992/A992M - Standard Specification for Structural Steel Shapes; 2022.

M. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.

N. ASTM A1018A/A1018M - Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Carbon, Commercial, Drawing, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; Current Edition.

O. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.

P. ASTM F1267 - Standard Specification for Metal, Expanded, Steel; 2018 (Reapproved 2023).

Q. ASTM F1941/F1941M - Standard Specification for Electrodeposited Coatings on Mechanical Fasteners, Inch and Metric; 2016.

R. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).

S. NAAMM AMP 500-06 - Metal Finishes Manual; 2006.

T. NAAMM AMP 510 - Metal Stairs Manual; 1992.

U. NAAMM MBG 531 - Metal Bar Grating Manual; 2024.

V. SDI (DM) - Publication No.30, Design Manual for Composite Decks, Form Decks, and Roof Decks; 2007.

W. SSPC-PA 1 - Shop, Field, and Maintenance Coating of Metals; 2024.

X. SSPC-SP 3 - Power Tool Cleaning; 2024.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Work Completed under this section must be coordinated with other work using BIM modelling. See Section 01 31 00.05 for requirements.

1.05 PERFORMANCE REQUIREMENTS

A. Design stairs and components, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads including finishes and the following loads and stresses within limits and under conditions indicated.
   1. Uniform Live Load: 100 lbf/sq. ft. (4.79 kN/sq. m).
   2. Concentrated Live Load: 300 lbf (1.33 kN) applied on an area of 4 sq. in. (2580 sq. mm).
   3. Uniform and concentrated loads need not be assumed to act concurrently.
   4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
   5. Limit deflection of treads, platforms, and framing members to L/240 or 1/4 inch (6.4 mm), whichever is less.

C. Structural Performance of Railings: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.
   1. Handrails and Top Rails of Guards:
      a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
      b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
      c. Uniform and concentrated loads need not be assumed to act concurrently.
   2. Infill of Guards:
      a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
      b. Infill load and other loads need not be assumed to act concurrently.

D. Seismic Performance: Metal stairs shall withstand the effects of earthquake motions determined according to ASCE 7/SEI 7.

1. Component Importance Factor is 1.25.

1.06 SUBMITTALS

A. Product Data: For metal stairs.

B. Submit BIM models as required by Section 01 31 00.05.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
   2. Shop Drawing submittals must conform with coordinated BIM models. See Section 01 31 00.05.
   3. Fabricator is responsible for designing and detailing all connections to supporting structures, including embedded items. All applied loads from the stairs to the support structure shall be clearly defined within the shop drawings.
   4. Include embedment drawings.
   5. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
   6. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.
   7. For stairs and components indicated to comply with design loads, include comprehensive structural analysis design data signed and sealed by qualified professional engineer, registered in the state of the project, responsible for their preparation.
      a. Calculation shall be organized, clear and concise and shall include table of contents and page numbers.
      b. Calculations shall be submitted concurrently with shop/erection drawings and shall be signed and sealed at time of submission.
      c. Shop Drawings received without corresponding calculations will not be reviewed by the Engineer.
   8. Resubmittals, if necessary, shall cloud and clearly identify revisions from previous submittals.

D. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.
   3. See Sections 01 33 00 and 01 60 00.

1.07 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Installer Qualifications: Fabricator of products.

C. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," for class of stair designated, unless more stringent requirements are indicated.
   1. Industrial-Type Stairs: Industrial class.
   2. Ornamental Stairs: Architectural class.

D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.08 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for metal stairs. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

C. Coordinate locations of hanger rods and struts with other work so that they will not encroach on required stair width and will be within the fire-resistance-rated stair enclosure.

PART 2 PRODUCTS

2.01 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.02 FERROUS METALS

A. Recycled Content of Steel Products: Provide products with average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.

B. General: Comply with the following: ASTM A572/A572M, ASTM A992/A992M.

C. Steel Plates, Shapes, and Bars: ASTM A36/A36M, ASTM A53/A53M.

D. Steel Tubing: ASTM A500/A500M (cold formed) or ASTM A513/A513M.

E. Rolled-Steel Floor Plate: SDI (DM), ASTM A786/A786M, rolled from plate complying with ASTM A36/A36M or ASTM A283/A283M, Grade C or D.

F. Steel Bars for Grating Treads: ASTM A36/A36M or steel strip, ASTM A1011/A1011M or ASTM A1018A/A1018M.

G. Wire Rod for Grating Crossbars: ASTM A510/A510M.

H. Uncoated, Hot-Rolled Steel Sheet: ASTM A1011/A1011M, either commercial steel, Type B, or structural steel, Grade 30 (Grade 205), unless another grade is required by design loads.

I. Expanded-Metal, Carbon Steel: ASTM F1267, Type I (expanded), Class 1 (uncoated).

J. Woven-Wire Mesh: Intermediate-crimp, diamond pattern, 2-inch (50-mm) woven-wire mesh, made from 0.135-inch (3.5-mm) nominal diameter wire complying with ASTM A510/A510M.

2.03 FASTENERS

A. General: Provide zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required.

2.04 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Shop Primers: Provide primers that comply with Division 9 painting Sections.

C. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
   1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

D. Concrete Materials and Properties: Comply with requirements in Division 3 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3,000 psi (20 MPa) unless otherwise indicated.

2.05 FABRICATION, GENERAL

A. Provide complete stair assemblies, including metal framing, hangers, struts, railings, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure. All components to comply with NAAMM AMP 510.
   1. Join components by welding unless otherwise indicated.
   2. Use connections that maintain structural value of joined pieces.
   3. Fabricate treads and platforms of exterior stairs so finished walking surfaces slope to drain.

B. Preassembled Stairs: Assemble stairs in shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

E. Form exposed work with accurate angles and surfaces and straight edges.

F. Weld connections to comply with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. Weld exposed corners and seams continuously unless otherwise indicated.
   5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 3 welds: partially dressed weld with spatter removed.

G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated. Locate joints where least conspicuous.

H. Fabricate joints that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

2.06 STEEL-FRAMED STAIRS

A. Stair Framing:
   1. Fabricate stringers of steel channels or tubes as indicated in Drawings.
      a. Provide closures for exposed ends of tube stringers.
   2. Construct platforms of steel channel or tube headers and miscellaneous framing members as indicated.
   3. Weld or bolt stringers to headers; weld or bolt framing members to stringers and headers. If using bolts, fabricate and join so bolts are not exposed on finished surfaces.
   4. Where stairs are enclosed by gypsum board assemblies, provide hanger rods or struts to support landings above or below. Locate hanger rods and struts where they will not encroach on required stair width and will be within the fire-resistance-rated stair enclosure.
      a. Hangers from construction above permitted only as indicated in Drawings. Coordinate all support conditions with Architect and Engineer.
   5. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.

B. Metal-Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness indicated.
   1. Steel Sheet: Uncoated hot-rolled steel sheet.
   2. Steel Sheet: Galvanized-steel sheet, where indicated.
   3. Directly weld metal pans to stringers; locate welds on top of subtreads where they will be concealed by concrete fill. Do not weld risers to stringers.
   4. Attach risers and subtreads to stringers with brackets made of steel angles or bars. Weld brackets to stringers and attach metal pans to brackets by welding, riveting, or bolting.

C. Metal Floor Plate Stairs: Form treads and platforms to configurations shown from checkered rolled-steel floor plate of thickness needed to comply with performance requirements, but not less than 1/8 inch (3.2 mm).
   1. Form treads with integral nosing and back edge stiffener. Form risers of same material as treads.
   2. Weld steel supporting brackets to stringers and weld treads to brackets.
   3. Fabricate platforms with integral nosings matching treads and weld to platform framing.

D. Metal Bar-Grating Stairs: Form treads and platforms to configurations shown from metal bar grating; fabricate to comply with NAAMM MBG 531, "Metal Bar Grating Manual."

1. Fabricate treads and platforms from welded or pressure-locked steel grating with 1-by-1/8-inch (25-by-3-mm) bearing bars at 7/16 inch (11 mm) o.c. and crossbars at 4 inches (100 mm) o.c.
2. Fabricate treads and platforms from welded or pressure-locked steel grating with openings in gratings no more than 5/16 inch (8 mm) in least dimension.
3. Surface: Serrated.
4. Finish: Shop primed.
5. Fabricate grating treads with rolled-steel floor plate nosing and with steel angle or steel plate carrier at each end for stringer connections. Secure treads to stringers with bolts.
6. Fabricate grating platforms with nosing matching that on grating treads. Provide toeplates at open-sided edges of grating platforms. Weld grating to platform framing.

2.07 RAILINGS

A. Comply with applicable requirements in Section 05 73 13 - Glazed Decorative Metal Railings.
   1. Rails may be bent at corners, rail returns, and wall returns, instead of using prefabricated fittings.
   2. Connect posts to stair framing by direct welding unless otherwise indicated.

B. Steel Tube Railings: Fabricate railings to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of tube, post spacings, and anchorage, but not less than that needed to withstand indicated loads.
   1. Rails and Posts: 1-5/8-inch- (41-mm-) diameter top and bottom rails.
   2. Picket Infill: Minimum of 1/2-inch- (13-mm-) pickets spaced less than 4 inches (100 mm) clear.
   3. Mesh Infill: Woven wire mesh crimped into 1-by-1/2-by-1/8-inch (25-by-13-by-3-mm) steel channel frames. Orient wire mesh with diamonds vertical.
   4. Gates: Form gates from steel tube of same size and shape as top rails, with infill to match guards. Provide with cam-type, self-closing hinges for fastening to wall and overlapping stop with rubber bumper to prevent gate from opening in direction opposite egress.

C. Welded Connections: Fabricate railings with welded connections. Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
   1. Finish welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 3 welds: partially dressed weld with spatter removed.

D. Form changes in direction of railings as follows:
   1. As detailed.
   2. By bending or by inserting prefabricated elbow fittings.

E. Close exposed ends of railing members with prefabricated end fittings.

F. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.

G. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and for attaching to other work. Furnish inserts and other anchorage devices for connecting to concrete or masonry work.
   1. Connect posts to stair framing by direct welding unless otherwise indicated.
   2. For galvanized railings, provide galvanized fittings, brackets, fasteners, sleeves, and other ferrous-metal components.
   3. For nongalvanized railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors embedded in exterior masonry and concrete construction.

H. Fillers: Provide fillers made from steel plate, or other suitably crush-resistant material, where needed to transfer wall bracket loads through wall finishes to structural supports. Size fillers to suit wall finish thicknesses and to produce adequate bearing area to prevent bracket rotation and overstressing of substrate.

2.08 FINISHES

A. Comply with NAAMM AMP 500-06 "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish metal stairs after assembly.

C. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed products:
   1. Interior Stairs: SSPC-SP 3, "Power Tool Cleaning."

D. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
   1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

E. See Spec Section 09 91 00 for final paint finish.

PART 3 EXECUTION

3.01 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
   1. Coordinate all required anchorage / fastening conditions with General Contractor prior to construction.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.

C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.

D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

E. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

F. Field Welding: Comply with requirements for welding in "Fabrication, General" Article.

G. Place and finish concrete fill for treads and platforms to comply with Section 03 30 00 - Cast-in-Place Concrete.

3.02 INSTALLING METAL STAIRS WITH GROUTED BASEPLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of baseplates.

B. Set steel stair baseplates on wedges, shims, or leveling nuts. After stairs have been positioned and aligned, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.
   1. Use nonmetallic, nonshrink grout unless otherwise indicated.
   2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.03 INSTALLING RAILINGS

A. Adjust railing systems before anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated or, if not indicated, as required by design loads. Plumb posts in each direction. Secure posts and rail ends to building construction as follows:
   1. Anchor posts to steel by welding directly to steel supporting members.
   2. Anchor handrail ends to concrete and masonry with steel round flanges welded to rail ends and anchored with postinstalled anchors and bolts.

B. Attach handrails to wall with wall brackets. Use type of bracket with predrilled hole for exposed bolt anchorage. Provide bracket with 1-1/2-inch (38-mm) clearance from inside face of handrail and

finished wall surface. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads. Secure wall brackets to building construction as follows:

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
2. For hollow masonry anchorage, use toggle bolts.
3. For steel-framed partitions, use hanger or lag bolts set into fire-retardant-treated wood backing between studs. Coordinate with stud installation to locate backing members.

3.04 ADJUSTING AND CLEANING

A. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 9 painting Sections.

END OF SECTION

SECTION 05 70 00
DECORATIVE METAL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Interior metal trim and reveals at tile and wood.

B. Interior metal wall guards.

C. Wire Mesh Partitions.

D. Decorative metal shelving.

1.02 RELATED SECTIONS

A. Section 01 31 00 - Project Management and Coordination.

B. Section 01 33 00 - Submittal Procedures.

C. Section 01 40 00 - Quality Requirements.

D. Section 01 60 00 - Product Requirements.

E. Section 05 50 00 - Metal Fabrications.

F. Section 08 81 00 - Glazing.

G. Section 09 21 16 - Gypsum Board Assemblies.

H. Section 09 75 00 - Interior Stone.

1.03 REFERENCE STANDARDS

A. ASTM B36/B36M - Standard Specification for Brass Plate, Sheet, Strip, and Rolled Bar; 2023.

B. ASTM B43 - Standard Specification for Seamless Red Brass Pipe, Standard Sizes; 2020.

C. ASTM B135/B135M - Standard Specification for Seamless Brass Tube; 2017.

D. ASTM B455/B455M - Standard Specification for Copper-Zinc-Lead Alloy (Leaded-Brass) Extruded Shapes; 2020.

E. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.

F. ASTM F1941/F1941M - Standard Specification for Electrodeposited Coatings on Mechanical Fasteners, Inch and Metric; 2016.

G. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).

H. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).

I. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).

J. AWS D1.6/D1.6M - Structural Welding Code - Stainless Steel; 2017, with Amendment (2021).

K. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2017, with Editorial Revision (2020).

L. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2023.

1.04 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.

C. Shop Drawings: Submit the following:
   1. Full size templates for products requiring templates for fabrication.
   2. Drawings indicating locations of products of this section in project.

3. Drawings and details indicating sizes, materials and thicknesses, fabrication and installation techniques, provisions for reinforcement and anchoring, joinery, finishes, fasteners and accessory items.

D. Samples for Initial Selection: For products involving selection of color, texture, or design.

E. Samples for Verification: For each type of exposed finish.
   1. Sections of linear shapes.
   2. Full-size Samples of castings and forgings.
   3. Samples of welded and brazed joints showing quality of workmanship and color matching of materials.

F. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.
   3. See Sections 01 33 00 and 01 60 00.

1.05 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Fabricator Qualifications: A firm experienced in producing decorative metal similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

C. Installer Qualifications: A firm approved by Fabricator of products to perform installation, with at least (5) years demonstrated experience in installing products of this type.

D. Finisher Qualifications: A firm experienced in successfully applying the specified finishes or coating indicated and employing competent control personnel to conduct continuing, effective quality-control to ensure compliance with requirements.

E. Welding Qualifications: Qualify procedures and personnel according to the following:
   1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
   2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
   3. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."
   4. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

F. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
   1. Build mockups for the following types of decorative metal:
      a. To be determined by owner.
   2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Packing, Shipping, Handling and Unloading: Pack products of this section to prevent damage to products and finishes.

B. Storage and Protection:
   1. Store products in manufacturer's unopened packaging until installation.
   2. Maintain dry, heated storage area for products until installation.

1.07 SEQUENCING

A. Ensure that locating templates and other information required for installation of products of this section are furnished to affected trades in time to prevent interruption of construction progress.

B. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

1.08 SCHEDULING

A. Supply full size templates for products requiring templates for fabrication to manufacturer of products of this section in time for scheduled fabrication.

PART 2 PRODUCTS

2.01 DECORATIVE METAL FABRICATORS

A. Metal fabricator by Contractor, Fabricators: Subject to compliance with requirements.

2.02 METALS, GENERAL

A. Metal Surfaces, General: Use materials with smooth, flat surfaces unless otherwise indicated. Use materials without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
   1. Extruded Shapes: ASTM B455/B455M, Alloy UNS C38500 (architectural bronze).
   2. Pipe: ASTM B43, Alloy UNS C23000 (red brass, 85 percent copper).
   3. Tube: ASTM B135/B135M, Alloy UNS C23000 (red brass, 85 percent copper).
   4. Retain one or all three options in "Castings" Paragraph below.
   5. Plate, Sheet, Strip, and Bars: ASTM B36/B36M, Alloy UNS C28000 (muntz metal, 60 percent copper).

2.03 PRODUCTS

A. Interior metal trim and reveals:
   1. MTL-1
      a. Manufacturer: Stylmark.
      b. Product Number: 110665
      c. Size: ½"w x ¼"d Bar.
      d. Color: Brushed Brite Aged Brass 21BRS80003.
      e. Location: TL-5 Elevator Walls – See Elevations and details.
   2. MTL-2
      a. Manufacturer: Stylmark.
      b. Product Number: 110419
      c. Size:3" w x 1/8"d Bar.
      d. Color:
         1) Brushed Brite Brown 216.
         2) Brushed Brite Aged Brass 21BRS80003.
      e. Location: Light Coves T-5 Elevator Wall Opening – See Elevations and details.
   3. MTL-3
      a. Manufacturer: Stylmark.
      b. Product Number: 110099
      c. Size: ¾” x 1/16” Bar.
      d. Color: Brushed Brite Aged Brass 21BRS80003.
      e. Location: Coffee Bar service, POS and Ceiling, Columns, Club Hub Millwork – see drawings.
   4. MTL-4
      a. Manufacturer: Stylmark.
      b. Product Number: 110994
      c. Size: ½” x 1” x 1/8” Angle.
      d. Color: Brushed Brite Aged Brass 21BRS80003.
      e. Location: Reception Desk, Residential Check-In Millwork – See drawings.
   5. MTL-5
      a. Manufacturer: Stylmark.
      b. Product Number: 110993.
      c. Size: Outside Corner.
      d. Color: Brushed Brite Aged Brass 21BRS80003.
      e. Location: Club Hub Millwork – see drawings.

6. MTL-6
    a. Manufacturer: Stylmark.
    b. Product Number: 110167
    c. Size: 2" x 2" Angle.
    d. Brushed Brite Aged Brass 21BRS80003.
    e. Location: Outside Corners, see drawings.
7. MTL-7
    a. Manufacturer: Stylmark.
    b. Product Number: 110080
    c. Size: ¾” x 1” x 1/16” U Channel.
    d. Color: Brushed Brite Aged Brass 21BRS80003.
    e. Location: Coffee Bar Service Line.
8. MTL-8
    a. Manufacturer: FR.
    b. Product Number: MWR7550
    c. Size: ¾” x 1” x 1/16” U Channel.
    d. Finish: Anodized Brushed Brite Light Bronze 212.
    e. Location: See Drawings.
9. MTL-10
    a. Fry Reglet.
    b. Product Number: #MWROSC75
    c. Size: 3/4" x 3/4" x 1 1/2"
    d. Finish: Anodized Brushed Brite Lite Bronze 212.
    e. Location: See Drawings.
10. MTL-11
    a. Fry Reglet.
    b. Millwork corner key.
    c. Product Number: #MWCK75
    d. Size: See Drawings.
    e. Finish: Anodized Brushed Brite Lite Bronze 212.
    f. Location: See Drawings.
11. MTL-12
    a. Manufacturer: Stylmark.
    b. Product Number: 110987
    c. Size: 7" x .070" Bar.
    d. Color:
        1) Brushed Brite Brown 216
        2) Brushed Brite Aged Brass 21BRS80003
    e. Location: Light Coves - See Drawings.
12. MTL-13
    a. Manufacturer: Stylmark.
    b. Product Number: 110307
    c. Size: 2" x 5/8"
    d. Color:
        1) Deep Brown 12BRN80013
    e. Base: Aluminum, 410466.
    f. Location: See Drawings.
13. MTL-14
    a. Manufacturer: Stylmark.
    b. Product Number: 150014
    c. Size: 1 1/2" x 3/4" x 3/32"
    d. Color:

1) Brushed Brite Brown 216
e. Location: Café Entry, Indoor Liquor Bar base trim.

14. MTL-15
a. Manufacturer: Stylmark.
b. Product Number: Stylmark Angle 110180
c. Color:
1) 22BRN80049
d. Location: Furred out LED walls at Group Fitness, Barre and Cycle.

B. Interior metal wall guards.
1. Stainless steel tread plate pattern sheet, Type 304, 16 ga (.063") with #4 satin finish.
a. Pre-drilled for mechanical fasteners.
b. Panel sizes: As shown on drawings.
c. Panel trim:
1) Trim to be provided by Millwork provider. See Section 06 40 00.
d. Manufacturers and products:
1) Wallguard, Protector Series 2449.
2) Or Approved equal.

C. Wire Mesh Partitions:
1. WMP-1
a. Manufacturer: Banker Wire.
b. Product: M31Z-6 Crimp Style
c. Finish: Powder Coated - PCC-14 - See Section 09 91 00
d. Size: 240" H x 96" W
e. Location: Cafe
f. URL: https://www.bankerwire.com/products/m31z-6-architectural-woven-wire-mesh/
g. See 05 50 00 for framing.

D. Decorative Metal Shelves:
1. Prefabricated steel shelves with artificial patina:
a. Manufacturer: Delform Metal Fabrication.
b. Product: Custom shelving
c. Material: Cold rolled steel
d. Finish: Midnight
e. Laquer: Satin/Matte.
f. Location: Locker room vanities as indicated on drawings.

2.04 FASTENERS

A. Fastener Materials: Unless otherwise indicated, provide the following:
1. Aluminum Items: Type 304 stainless-steel fasteners.
2. Stainless-Steel Items: Type 304 stainless-steel fasteners.
3. Uncoated-Steel Items: Plated steel fasteners complying with ASTM B633, Class Fe/Zn 25 for electrodeposited zinc coating where concealed, Type 304 stainless-steel fasteners where exposed.
4. Galvanized-Steel Items: Plated steel fasteners complying with ASTM B633, Class Fe/Zn 25 for electrodeposited zinc coating.
5. Dissimilar Metals: Type 304 stainless-steel fasteners.

B. Fasteners for Anchoring to Other Construction: Unless otherwise indicated, select fasteners of type, grade, and class required to produce connections suitable for anchoring indicated items to other types of construction indicated.

C. Provide concealed fasteners for interconnecting components and for attaching decorative metal items to other work unless otherwise indicated.
1. Provide square or hex socket machine screws for exposed fasteners unless otherwise indicated.

D. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193 or ICC-ES AC308.
   1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5 unless otherwise indicated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. Verify openings and substrates are prepared to receive products of this section.

C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

A. Install in accordance with the manufacturers recommendations and the approved shop drawings.

B. Install plumb, level, square, and securely and in accordance with manufacturer’s instructions.

C. Factory-Painted Surfaces: Do not cut, drill, or weld unless required by approved shop drawings.

D. Protect against contact between dissimilar metals.

E. Where appropriate, supply products of this section for installation by installers of products of other sections.

3.04 PROTECTION

A. Protect installed products until completion of project.

B. Replace damaged products before Substantial Completion.

END OF SECTION

SECTION 05 73 13
GLAZED DECORATIVE METAL RAILINGS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Decorative railings with glass guard infill.
   2. Stainless steel guardrail cap.
   3. Stainless steel handrails.
   4. Aluminum base shoe.
   5. Stainless steel cladding over guardrail base shoe.
   6. Stainless steel wall mounted tubular handrails at pool circulation areas.

1.02 RELATED REQUIREMENTS

A. Section 01 31 00 - Project Management and Coordination.

B. Section 01 33 00 - Submittal Procedures.

C. Section 01 40 00 - Quality Requirements.

D. Section 01 60 00 - Product Requirements.

E. Section 05 50 00 - Metal Fabrications.

F. Section 05 51 00 - Metal Stairs.

G. Section 08 81 00 - Glazing.

1.03 DEFINITIONS

A. Railings: Guards, handrails, and similar devices used for protection of occupants at open-sided floor areas, pedestrian guidance and support, visual separation, or wall protection.

1.04 REFERENCE STANDARDS

A. AAMA CW 12 - Structural Properties of Glass; 1984.

B. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes; 2024.

C. ASTM A312/A312M - Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes; 2022a.

D. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.

E. ASTM A743/A743M - Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application; 2021.

F. ASTM B26/B26M - Standard Specification for Aluminum-Alloy Sand Castings; 2018, with Editorial Revision.

G. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.

H. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

I. ASTM B247 - Standard Specification for Aluminum and Aluminum-Alloy Die Forgings, Hand Forgings, and Rolled Ring Forgings; 2020.

J. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2020.

K. ASTM E488/E488M - Standard Test Methods for Strength of Anchors in Concrete Elements; 2022.

L. ASTM E894 - Standard Test Method for Anchorage of Permanent Metal Railing Systems and Rails for Buildings; 2018.

M. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings; 2021.

N. NAAMM AMP 500-06 - Metal Finishes Manual; 2006.

1.05 PERFORMANCE REQUIREMENTS

A. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:
   1. Aluminum: The lesser of minimum yield strength divided by 1.65 or minimum ultimate tensile strength divided by 1.95.
   2. Stainless Steel: 60 percent of minimum yield strength.
   3. Glass: 25 percent of mean modulus of rupture (50 percent probability of breakage), as listed in "Mechanical Properties" in AAMA CW 12, "Structural Properties of Glass."

B. Design railing system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

C. Structural Performance:
   1. Handrails and Top Rails of Guards:
      a. Uniform load of 50 pounds per linear foot. (0.73 kN/m) applied in any direction.
      b. Concentrated load of 200 lbs applied in any direction.
      c. Uniform and concentrated loads need not be assumed to act concurrently.
   2. Infill of Guards:
      a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
      b. Infill load and other loads need not be assumed to act concurrently.
   3. Glass-Supported Railings: Support each section of top rail by a minimum of three glass panels or by other means so top rail will remain in place if any one panel fails.

D. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.06 SUBMITTALS

A. Product Data: For the following:
   1. Manufacturer's product lines of railings assembled from standard components.
   2. Grout, anchoring cement, and paint products.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

C. Delegated-Design Submittal: For railing system indicated to comply with performance requirements and design criteria, including calculations signed and sealed by the qualified professional engineer responsible for their preparation.

D. Samples for Verification: For each type of exposed finish required.
   1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
   2. Each type of glass required.
   3. Fittings and brackets.

E. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.
   3. See Sections 01 33 00 and 01 60 00.

F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, according to ASTM E894 and ASTM E935.

1.07 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Source Limitations: Obtain each type of railing from single source from single manufacturer.

C. Product Options: Information on Drawings and in Specifications establishes requirements for system's aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including structural analysis, preconstruction testing, field testing, and in-service performance.

D. Safety Glazing Labeling: Permanently mark glass with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction or manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

1.08 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication and indicate measurements on Shop Drawings.

1.09 COORDINATION AND SCHEDULING

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not suit structural performance requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Decorative Railings:
      a. Global Glass Railings.
      b. Julius Blum & Co., Inc.
      c. Blumcraft, a division of C.R. Laurence Co., Inc.
      d. Hollaender Manufacturing Co.
      e. Or approved equal.

2.02 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Same metal and finish as supported rails unless otherwise indicated.
   1. Provide extruded-aluminum brackets with interlocking pieces that conceal anchorage. Locate set screws on bottom of bracket.

2.03 ALUMINUM

A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with strength and durability properties for each aluminum form required not less than that of alloy and temper designated below.

B. Extruded Bars and Shapes: ASTM B221 (ASTM B221M), Alloy 6063-T5/T52.

C. Plate and Sheet: ASTM B209/B209M, Alloy 6061-T6.

D. Die and Hand Forgings: ASTM B247, Alloy 6061-T6.

E. Castings: ASTM B26/B26M, Alloy A356.0-T6.

2.04 STAINLESS STEEL

A. Pipe: ASTM A312/A312M, Grade TP 304.

B. Castings: ASTM A743/A743M, Grade CF 8 or CF 20.

C. Sheet, Strip, Plate, and Flat Bar: ASTM A666, Type 304.

D. Bars and Shapes: ASTM A276/A276M, Type 304.

2.05 GLASS AND GLAZING MATERIALS

A. See Section 08 81 00.

B. Glazing Gaskets for Glass Infill Panels: Glazing gaskets and related accessories recommended or supplied by railing manufacturer for installing glass infill panels in post-supported railings.

2.06 FASTENERS

A. Fastener Materials: Unless otherwise indicated, provide the following:
   1. Aluminum Components: Type 304 stainless-steel fasteners.
   2. Stainless-Steel Components: Type 304 stainless-steel fasteners.
   3. Dissimilar Metals: Type 304 stainless-steel fasteners.

B. Fasteners for Anchoring to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

C. Provide concealed fasteners for interconnecting railing components and for attaching railings to other work unless otherwise indicated.
   1. Provide tamper-resistant flat-head machine screws for exposed fasteners unless otherwise indicated.

D. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.

2.07 MISCELLANEOUS MATERIALS

A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

B. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

2.08 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate. Locate weep holes in inconspicuous locations.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Connections: Fabricate railings with welded connections at curved stairs and nonwelded connections at straight stairs unless otherwise indicated.

H. Mechanical Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
   1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.

I. Form changes in direction as follows:
   1. Miter corners, welded and finished to # 4 satin.
   2. By bending or by inserting prefabricated elbow fittings.
   3. By radius bends of radius indicated.

J. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

K. Close exposed ends of hollow railing members with prefabricated end fittings. End caps provided shall have smooth edges and fit the exact profile of the handrail pipe.

L. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns, unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.

M. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
   1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers, or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.

N. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

O. For railing posts set in concrete, provide stainless-steel sleeves not less than 6 inches (150 mm) long with inside dimensions not less than 1/2 inch (13 mm) greater than outside dimensions of post, with metal plate forming bottom closure.

2.09 GLAZING PANEL FABRICATION

A. General: Fabricate to sizes and shapes required; provide for proper edge clearance and bite on glazing panels.
   1. Clean-cut or flat-grind edges at butt-glazed sealant joints to produce square edges with slight chamfers at junctions of edges and faces.
   2. Grind smooth exposed edges, including those at open joints, to produce square edges with slight chamfers at junctions of edges and faces.

B. Structural Balusters: Provide tempered glass panels.

2.10 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM AMP 500-06 "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.

C. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.11 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

C. Directional Satin Finish: No. 4.

D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

2.12 METAL CLADDING

A. Material: Stainless Steel.

B. Finish: Powder Coated to match handrail.

C. Attachment: Construction adhesive and VHB tape.

D. Location: Grand Stair, see drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.02 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting. Provide field finishing for railing components that are required to be welded or cut in the field.
2. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (5 mm in 3 m).

C. Adjust railings before anchoring to ensure matching alignment at abutting joints.

D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.03 RAILING CONNECTIONS

A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings. Seal recessed holes of exposed locking screws using stainless steel cement filler colored to match finish of railings.

B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

3.04 ANCHORING POSTS

A. Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.

B. Form or core-drill holes not less than 5 inches (125 mm) deep and 3/4 inch (20 mm) larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.

C. Cover anchorage joint with flange of same metal as post, attached to post with set screws.

D. Leave anchorage joint exposed with anchoring material flush with adjacent surface.

E. Anchor posts to metal surfaces with flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:

1. For stainless-steel railings, weld flanges to posts and bolt to metal-supporting surfaces.

3.05 ATTACHING RAILINGS

A. Anchor railing ends to concrete and masonry with sleeves concealed within railing ends and anchored to wall construction with anchors and bolts.

B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and connected to railing ends using nonwelded connections.

C. Attach handrails to walls with wall brackets except where end flanges are used. Provide brackets with 1-1/2-inch (38-mm) clearance from inside face of handrail and finished wall surface. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
   1. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt.
   2. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

D. Secure wall brackets to building construction as follows:
   1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
   2. For hollow masonry anchorage, use toggle bolts.
   3. For steel-framed partitions, use hanger or lag bolts set into fire-retardant-treated wood backing between studs. Coordinate with stud installation to locate backing members.
   4. For steel-framed partitions, fasten brackets directly to steel framing or concealed steel reinforcements using self-tapping screws of size and type required to support structural loads.
   5. For steel-framed partitions, fasten brackets with toggle bolts installed through flanges of steel framing or through concealed steel reinforcements.

3.06 INSTALLING GLASS PANELS

A. Glass-Supported Railings: Install assembly to comply with railing manufacturer's written instructions.
   1. Attach base channel to building structure, then insert and connect factory-fabricated and assembled glass panels.
   2. Attach base channel to building structure, then insert glass into base channel and bond with glazing cement.
      a. Support glass panels in base channel at quarter points with channel-shaped setting blocks that also act as shims to maintain uniform space for glazing cement. Fill remaining space in base channel with glazing cement for uniform support of glass.
   3. Adjust spacing of glass panels so gaps between panels are equal before securing in position.

3.07 INSTALLING GUARDRAIL CAPS

A. Apply stainless steel guardrail caps, where indicated, complying with manufacturer's written instructions for cutting, mounting, forming, welding, cleaning, applying end caps, and finishing.

B. Minimize number of joints in stainless steel caps by installing in lengths as long as possible. Allow for shortening of stainless steel cap caused by welding and splicing process; butt ends together to produce hairline joint.

3.08 CLEANING

A. Clean stainless steel by washing thoroughly with clean water and soap, rinsing with clean water, and wiping dry.

B. Clean and polish glass as recommended in writing by manufacturer. Wash both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion.
   1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

3.09 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION

SECTION 05 77 30
SMOKE BAFFLE SYSTEM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Pre-engineered, component-based, draft curtain system.

1.02 RELATED SECTIONS

A. Section 01 33 00 - Submittal Procedures.

B. Section 01 40 00 - Quality Requirements.

C. Section 01 60 00 - Product Requirements.

D. Section 01 92 00 - Facility Operation and Maintenance.

E. Section 05 72 00 - Ornamental Handrails and Railings.

F. Section 08 81 00 - Glazing.

1.03 REFERENCES

A. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015 (Reaffirmed 2020).

B. ASTM E985 - Standard Specification for Permanent Metal Railing Systems and Rails for Buildings; Current Edition.

1.04 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

1.05 SUBMITTALS

A. Comply with Section 01 33 00 - Submittal Procedures.

B. Product Data: Submit manufacturer's product data, including description of materials, components, fabrication, finishes and installation instructions. Installation instructions include all structural computations and test reports provided by the manufacturer evidencing compliance with the specifications.

C. Shop Drawings: Submit manufacturer's shop drawings, including plans, elevations, sections, and details, indicating materials, components, sizes, dimensions, tolerances, hardware, fasteners, finishes, options, accessories, and installation. Show details of attaching draft curtain system to supports.

D. Submit manufacturer's samples of standard materials, finishes, colors, and textures.

E. Test Reports: Submit test reports from qualified independent testing agency indicating compliance with ASTM E985.

F. Manufacturer's Quality Assurance: Submit manufacturer's certification that materials comply with specified requirements and are suitable for intended application. Submit certification that the manufacturer has not less than 5 years experience producing the product specified in this section. Installation of this product will be done by the manufacturer or an approved installer.

G. Operation and Maintenance Data: Submit O&M manuals according to the requirements of Section 01 92 00 - Facility Operation and Maintenance.

H. Warranty: Submit manufacturer's standard warranty.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.

B. Storage: Store materials in clean, dry area indoors in accordance with manufacturer's instructions.

C. Handling: Protect materials and finish from damage during handling and installation.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. C.R. Laurence.
   1. P.O. Box 208952
   2. Dallas, TX 75320-8952
   3. Phone (800) 421-6144
   4. Web Site: https:crlaurence.com

B. Approved equal.

2.02 SMOKE BAFFLE SYSTEM (DRAFT CURTAIN)

A. Pre-Engineered, Component-Based, Draft Curtain System:
   1. Base 1 1/2” x 3” extruded aluminum.
   2. Glass: 3/8-inch thick clear tempered plate glass.
      a. Glazing Material: ANSI Z97.1 .
      b. Field glaze glass panels.
   3. Finish: Clear Anodized Aluminum.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas to receive draft curtain system. Notify Architect if areas are not acceptable. Do not begin installation until unacceptable conditions have been corrected.

3.02 INSTALLATION

A. Install draft curtain system in accordance with manufacturer's instructions using manufacturer’s trained installers or an installer acceptable to the specified manufacturer.

B. Install draft curtain system plumb, level, square, true to line, and rigid.

C. Attach draft curtain system securely in place using fasteners supplied or approved by manufacturer. All embedded anchor plates and supporting steel shall be provided by another trade and coordinated with the draft curtain supplier.

D. Attach draft curtain system to supports as indicated on the drawings and as approved by manufacturer.

E. Field weld components as approved by manufacturer.

F. Use manufacturer's supplied hardware.

G. Repair minor damages to finish in accordance with manufacturer's instructions and as approved by Architect.

H. Remove and replace defective or damaged components that cannot be successfully repaired as determined by Architect.

3.03 CLEANING

A. Clean draft curtain system promptly after installation in accordance with manufacturer's instructions.

B. Do not use harsh cleaning materials or methods that would damage glass or finish.

C. Do not use abrasive cleaners.

3.04 PROTECTION

A. Protect installed draft curtain system and finish from damage during other construction.

END OF SECTION

SECTION 06 10 00
ROUGH CARPENTRY

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes the following:
   1. Framing with dimension lumber.
   2. Rooftop equipment bases and support curbs.
   3. Wood blocking, cants, and nailers.
   4. Wood furring and grounds.
   5. Wood sleepers.
   6. Plywood backing panels.

1.02 RELATED SECTIONS

A. Section 01 33 00 - Submittal Procedures.
B. Section 01 40 00 - Quality Requirements.
C. Section 01 45 33 - Code-Required Special Inspections and Procedures.
D. Section 01 60 00 - Product Requirements.
E. Section 03 30 00 - Cast-in-Place Concrete.
F. Section 05 12 00 - Structural Steel Framing.
G. Section 05 31 00 - Steel Decking.
H. Section 05 40 00 - Cold-Formed Metal Framing.
I. Section 05 50 00 - Metal Fabrications.
J. Section 05 51 00 - Metal Stairs.
K. Section 06 15 00 - Wood Decking.
L. Section 06 20 00 - Finish Carpentry.
M. Section 06 40 00 - Architectural Woodwork.
N. Section 07 21 00 - Thermal Insulation.
O. Section 07 27 26 - Fluid-Applied Membrane Air Barrier.
P. Section 07 42 00 - Metal Wall Panels.
Q. Section 07 54 23 - Thermoplastic Polyolefin (TPO) Roofing.
R. Section 07 62 00 - Sheet Metal Flashing and Trim.
S. Section 07 72 33 - Roof Hatches.
T. Section 08 11 13 - Hollow Metal Doors and Frames.
U. Section 08 14 16 - Flush Wood Doors.
V. Section 08 31 13 - Access Doors and Frames.
W. Section 08 38 00 - Traffic Doors.
X. Section 08 41 13 - Aluminum Framed Entrances and Storefronts.
Y. Section 08 42 45 - Sliding Aluminum Doors.
Z. Section 08 44 13 - Glazed Aluminum Curtainwalls.
AA. Section 09 21 16 - Gypsum Board Assemblies.
BB. Section 10 14 00 - Signage.
CC. Section 10 21 13.16 - Plastic Laminate Clad Toilet Compartments.
DD. Section 10 28 13 - Toilet and Bath Accessories.

EE. Section 11 40 00 - Food Service Equipment.

FF. Section 11 66 00 - Athletic Equipment.

GG. Section 11 66 43 - Scoreboards, Timers and Clocks.

HH. Section 12 56 90 - Spa Furniture.

II. Section 13 24 16 - Saunas.

1.03 REFERENCE STANDARDS

A. AHA A135.4 American Hardboard Association; Basic Hardboard.

B. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; Current Edition.

C. AFPA (NDS) - National Design Specification for Wood Construction; 2018.

D. ASME B18.2.1 - Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series); 2012 (Reaffirmed 2021).

E. ASME B18.6.1 - Wood Screws; 2016.

F. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.

G. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.

H. ASTM A563/A563M - Standard Specification for Carbon and Alloy Steel Nuts (Inch and Metric); 2021a.

I. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

J. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.

K. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2022.

L. ASTM D3498 - Standard Specification for Adhesives for Field-Gluing Wood Structural Panels (Plywood or Oriented Strand Board) to Wood Based Floor System Framing; 2019a.

M. ASTM E488/E488M - Standard Test Methods for Strength of Anchors in Concrete Elements; 2022.

N. ASTM F1667/F1667M - Standard Specification for Driven Fasteners: Nails, Spikes, and Staples; 2021a.

O. AWPA M4 - Standard for the Handling, Storage, Field Fabrication and Field Treatment of Preservative-Treated Wood Products; 2023.

P. AWPA U1 - Use Category System: User Specification for Treated Wood; 2024.

Q. ESR 1539 - Power Driven Staples and Nails; 2019.

R. PS 1 - Structural Plywood; 2023.

S. PS 20 - American Softwood Lumber Standard; 2025.

T. AWI/AWMAC/WI (AWS) American Woodworking Institute; Woodworking Standards.

1.04 DEFINITIONS

A. Dimension Lumber: Lumber of 2 inches nominal (38 mm actual) or greater but less than 5 inches nominal (114 mm actual) in least dimension.

1.05 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00.

1.06 SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
   1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
   2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
   3. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
   4. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

B. Perform and submit reports of Code Required Special Inspections as required in Section 01 45 33.

C. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.
   3. See Sections 01 33 00 and 01 60 00.

D. Research/Evaluation Reports: For the following, showing compliance with building code in effect for Project.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

B. Deliver interior wood materials that are to be exposed to view only after building is enclosed and weatherproof, wet work other than painting is dry, and HVAC system is operating and maintaining temperature and humidity at occupancy levels.

PART 2 PRODUCTS

2.01 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
   1. Factory mark each piece of lumber with grade stamp of grading agency.
   2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
   3. Provide dressed lumber, S4S, unless otherwise indicated.

2.02 WOOD-PRESERVATIVE-TREATED MATERIALS

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.
   1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.
   2. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

D. Application: Treat all miscellaneous carpentry, unless otherwise indicated.

1. Wood sills, sleepers, blocking, furring, and similar concealed members in contact with masonry or concrete.
2. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
3. Wood framing members that are less than 18 inches (460 mm) above the ground in crawl spaces or unexcavated areas.
4. Wood floor plates that are installed over concrete slabs-on-grade.

2.03 FIRE-RETARDANT-TREATED MATERIALS (FRT)

A. General: Comply with performance requirements in AWPA U1.
   1. Use treatment that does not promote corrosion of metal fasteners.
   2. Use Interior Type A for interior locations, unless otherwise indicated.
   3. Use Exterior Grade Fire X for exterior conditions, unless otherwise indicated.

B. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.

C. Application: Treat all miscellaneous carpentry, unless otherwise indicated.

2.04 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
   1. Blocking.
   2. Nailers.
   3. Rooftop equipment bases and support curbs.
   4. Furring.

B. For items of dimension lumber size, provide Standard, Stud, or No. 3 grade lumber with 19 percent maximum moisture content of any species.

C. For blocking not used for attachment of other construction Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

D. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

E. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.05 PLYWOOD BACKING PANELS

A. Telephone and Electrical Equipment Backing Panels: DOC PS 1, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch (19-mm) nominal thickness.

B. Other Applications:
   1. Plywood Concealed From View But Located Within Exterior Enclosure: PS 1, C-C Plugged or better, Exterior grade.
   2. Plywood Exposed to View But Not Exposed to Weather: PS 1, A-D, or better.
   3. Other Locations: PS 1, C-D Plugged or better.

2.06 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
   1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.

B. Nails, Brads, and Staples: ASTM F1667/F1667M.

C. Power-Driven Fasteners: ESR 1539 or NES NER-272.

D. Wood Screws: ASME B18.6.1.

E. Screws for Fastening to Cold-Formed Metal Framing: ASTM C954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

F. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).

G. Bolts: Steel bolts complying with ASTM A307, Grade A (ASTM F568M, Property Class 4.6); with ASTM A563/A563M hex nuts and, where indicated, flat washers.

H. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E488/E488M conducted by a qualified independent testing and inspecting agency.
   1. Material: Carbon-steel components, zinc plated to comply with ASTM B633, Class Fe/Zn 5.

2.07 METAL FRAMING ANCHORS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Simpson Strong-Tie Co., Inc.
   2. USP Structural Connectors.

C. Galvanized Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A653/A653M, G60 (Z180) coating designation.

2.08 MISCELLANEOUS MATERIALS

A. Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D3498 that is approved for use indicated by adhesive manufacturer.
   1. Use adhesives that have a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 EXECUTION

3.01 INSTALLATION, GENERAL

A. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.

B. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

C. Framing Standard: Comply with AFPA (NDS) "Details for Conventional Wood Frame Construction," unless otherwise indicated.

D. Metal Framing Anchors: Install metal framing to comply with manufacturer's written instructions.

E. Do not splice structural members between supports, unless otherwise indicated.

F. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
   1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches (406 mm) o.c.

G. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:
   1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches (2438 mm) o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
   2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches (2438 mm) o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal- (38-mm actual-) thickness.

3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. (9.3 sq. m) and to solidly fill space below partitions.

H. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

I. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
   1. Use inorganic boron for items that are continuously protected from liquid water.
   2. Use copper naphthenate for items not continuously protected from liquid water.

J. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood; do not countersink nail heads, unless otherwise indicated.

3.02 WOOD GROUND, SLEEPER, BLOCKING, AND NAILER INSTALLATION

A. Install where indicated and where required for screeding or attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated.

3.03 WOOD FURRING INSTALLATION

A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.

B. Furring to Receive Plywood or Hardboard Paneling: Install 1-by-3-inch nominal- (19-by-63-mm actual-) size furring horizontally and vertically at 24 inches (610 mm) o.c.

C. Furring to Receive Gypsum Board: Install 1-by-2-inch nominal- (19-by-38-mm actual-) size furring vertically at 16 inches (406 mm) o.c.

3.04 WOOD TRIM INSTALLATION

A. Install with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than 24 inches (610 mm) long except where necessary. Stagger joints in adjacent and related standing and running trim. Cope at returns and miter at corners to produce tight-fitting joints with full-surface contact throughout length of joint. Use scarf joints for end-to-end joints.
   1. Match color and grain pattern across joints.
   2. Install trim after gypsum board joint-finishing operations are completed.
   3. Drill pilot holes in hardwood before fastening to prevent splitting. Fasten to prevent movement or warping. Countersink fastener heads and fill holes.
   4. Install to tolerance of 1/8 inch in 96 inches (3 mm in 2438 mm) for level and plumb. Install adjoining finish carpentry with 1/32-inch (0.8-mm) maximum offset for flush installation and 1/16-inch (1.6-mm) maximum offset for reveal installation.

END OF SECTION

SECTION 06 1613
STRUCTURAL INSULATING SHEATHING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Structural Insulated Sheathing panels, to be used as a substrate for cladding materials while providing continuous insulation.

1.02 RELATED REQUIREMENTS

A. Section 01 33 00 - Submittal Procedures.

B. Section 01 40 00 - Quality Requirements.

C. Section 01 60 00 - Product Requirements.

D. Section 05 40 00 - Cold-Formed Metal Framing.

E. Section 06 10 00 - Rough Carpentry.

F. Section 07 21 00 - Thermal Insulation.

G. Section 07 27 26 - Fluid Applied Membrane Air Barriers.

H. Section 07 62 00 - Sheet Metal Flashing and Trim.

I. Section 07 92 00 - Joint Sealants.

J. Section 09 21 16 - Gypsum Board Assemblies.

1.03 REFERENCE STANDARDS

A. ASTM E84, “Standard Test Method for Surface Burning Characteristics of Building Materials”.

B. ASTM D137-12, “Standard Test Method for Evaluating Properties of Wood based Fiber and Particle Panel Materials”, Section 15: Nail Head Pull Through.

C. ASTM E2357, “Air Leakage of Building Assemblies”.

D. ASHRAE 90.1-2013, “Energy Standard for Buildings Except Low-Rise Residential Buildings”.

E. ASTM E283-04 (2012), “Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors under Specified Pressure Differences across the Specimen”.

F. ASTM E331-00 (2016), “Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference”.

G. Testing Application Standard (TAS) 202-94, “Impact & Nonimpact Resistance Building Envelope Components using Uniform Static Air Pressure”.

H. Testing Application Standard (TAS) 203-94, “Criteria for Testing Products Subject to Cyclic Wind Pressure Loading”.

I. ASTM E72-05, “Standard Test Method of Conducting Strength Tests of Panels for Building Construction”.

J. ASTM C518-17, “Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter”.

K. ASTM D1929-12, “Standard Test Method for Determining Ignition Temperature of Plastics.

L. ASTM E96-13, “Test Method for Water Vapor Transmission of Materials”.

M. ASTM C1304-08 (2013), “Standard Test Method for Assessing the Odor Emission of Thermal Insulation Materials”.

N. ASTM C1338-14, “Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings”.

O. ASTM D1761, “Standard Test Methods for Mechanical Fasteners in Wood” modified for Shear.

P. NFPA 285 (2012), “Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components”.

1.04 SUBMITTALS

A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.

B. Manufacturer’s Product Data: Submit data for structural insulating sheathing and accessories. Include instructions for handling, storage, installation, and protection.

C. Shop Drawings: Submit drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

D. Manufacturer's Installation Instructions: Indicate special handling criteria, installation sequence, cleaning procedures, and maintenance procedures.

E. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.
   3. See Sections 01 33 00 and 01 60 00.

F. Sample product warranty.

1.05 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Field Quality Control Plan:
   1. Visually inspect fasteners, flashings, and waterproofing.
   2. Photo document observations and maintain record of observations.

C. Installer Qualifications: Company specializing in performing the work of this Section with minimum 3 years’ experience.

D. Mock-up:
   1. Construct mock-up, 4 feet long by 4 feet wide, minimum, including panels, attachments to building frame, sealants and seals, and any other material in the assembly.
   2. Demonstrate component assembly including panel materials, corners (inside and outside), window openings, weep drainage system, attachments, anchors, and perimeter sealant.
   3. Locate where directed by Architect.
   4. Approved Mock-up may remain as part of the Work.

1.06 PROJECT CONDITIONS

A. Sheathing panels may be installed at any temperature.

B. Special consideration shall be followed for accessory sealants. Follow manufacturer’s instructions for temperature limitations on seam sealant requirements.

1.07 DELIVERY, STORAGE AND HANDLING

A. Transport and handle items in accordance with manufacturer’s instructions.

B. Coordinate deliveries in order to avoid delay in, or impediment of, progress of the Work.

C. Store packaged materials in original containers with seals unbroken and labels, including grade seal, intact until time of use, in accordance with manufacturer’s instructions. Do not stack.

D. Store installation system materials in a dry location and handle in a manner to prevent chipping, breakage, and contamination.

E. Store structural insulating sheathing boards off ground, under cover, and keep dry. Pallets shall sit on even gravel or concrete surface when able.

F. Maximum panel stack height 30 panels. Do not double stack pallets.

G. Long term panel storage shall be kept in a warehouse condition.

H. Protect latex additives, organic adhesives, epoxy adhesives and sealants from freezing or overheating in accordance with manufacturer's instructions; store at room temperature when possible.

1.08 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Provide manufacturer's Limited Ten Year Warranty.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Dupont, Armorwall. ArmorWall Manufacturing Plant, 1335 Litton Drive, Salisbury, North Carolina 28147

B. Basis of Design: Armorwall FR SIS.
   1. Magnesium Oxide Board (MgO) Facer; 1/2" thickness
   2. Polyurethane Rigid Foam Insulation:
      a. Class 1 Rated Polyurethane R-Value 6.5/inch.
      b. 1 1/2" Thickness R10.
   3. Air and Weather Resistant Barrier: As approved by Manufacturer and applied after installation of sheathing.
   4. Sheathing Panel System Maximum Deflection on 18ga Steel Stud. L/360: +113/-75 psf (+5400/-2600 Pa). L/240: +113/-95 psf (+5400/-4560 Pa).
   5. NFPA 285 approved test assembly demonstrating passing of sheathing directly to exterior of stud facing allowing any exterior non-combustible veneer application.

2.02 ACCESSORIES

A. Fasteners: Supplied by structural insulating sheathing manufacturer.
   1. For attachment to Cold Formed Steel Studs:
      a. Type: #14-13, self-drilling, pancake head fastener.
      b. Min embedment: Depth of steel stud plus three (3) threads.
   2. Joint and Fastener Head Treatment:
      a. See Below.
   3. Flashing: See Section 07 62 00 - Sheet Metal Flashing and Trim.

B. Rough Openings:
   1. ArmorWall Return to be applied to all rough openings prior to waterproofing application.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces and conditions are ready to accept the work of this section.

B. Verify built-in items, penetrations and rough openings are correct and properly located.

3.02 PREPARATION

A. Protect surrounding area from possible damage during installation of structural insulating sheathing.

B. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.

C. If deficiencies exist, consult Architect. Correct deficiencies in accordance with manufacturer's recommendations.

D. Beginning installation constitutes Contractor's acceptance of existing conditions.

3.03 SEQUENCING

A. Material may be cut to using standard power hand tools prior to final installation.

B. Coordinate installation of the structural insulating sheathing with related work.

C. Proceed with the Work only when substrate construction and framing of openings have been completed.

3.04 GENERAL

A. Structural insulating sheathing to be applied directly to exterior face of steel or wood studs with the rigid structural facing out and the insulation placed directly against the studs.

B. Structural insulating sheathing may be attached to concrete and masonry foundation walls. Rigid structural exterior surface is designed to receive direct application of siding, synthetic stone, thin brick, or other exterior finish systems with mechanical attachment directly to sheathing up to 13 psf. Consult with manufacturer's technical services for assemblies of heavier weights prior to installation.

C. Do not install structural sheathing on to slopes less than a forty-five degree (12 inches of rise per 12 inches of run).

3.05 INSTALLATION

A. Install materials in accordance with manufacturer's instructions. No insulation shall be exposed after installation.

B. Sheathing panels shall be installed in butt joint fashion with no gaps greater than 1/8". Gaps greater than 1/8" require installation of low rise foam to maintain continuous insulation requirements of wall assembly.

C. Installation at Steel Studs:
   1. Install panels vertically or horizontally to stud with butt joints at all locations.
   2. Layout shall permit panel joints to occur on the face of a stud of butt joints that are parallel to panel edge.
   3. Panel Perimeter Fasteners at 12 inches O.C. on the panel edge.
   4. Fasten panels according to manufacturer's written instructions.

D. Corner Condition; coordinate inside and outside corner installation for interlocking panel seam layout.
   1. Outside Corners - Miter both panels with power saw prior to installation so that outer structural face meets on each panel leaving no exposed insulation. Seal joints, seams, and all fastener penetrations.
   2. Inside Corner - Weave one corner behind and then butt joint following panel and seal.

E. Fluid Applied Coating:
   1. See Section 07 27 26 - Fluid Applied Membrane Air Barriers.
   2. Coat entire surface with Air Barrier per panel manufacturer's written instructions.
   3. Sealants and/or coatings shall be applied in smoothest way possible to buck as little water as possible shedding down vertical facing of sheathing.

F. Rough Opening and Large Penetration Conditions:
   1. ArmorWall Return to surround all rough openings through the entire face of exposed structural member with no insulation left exposed.
   2. Form butt joint with new structural insulated sheathing to return rigid face around the entire rough opening.
   3. Mechanically attach return to structural face of rough opening in offset fastening for entire run of opening face at eight (8) inches on center.
   4. Treat outer face seam with sealant on return and outer structural insulating sheathing with a minimum of one (1) inch of sealant on to each face.
   5. No insulation shall be left exposed and returns shall be installed at all rough openings or any openings that can't be immediately flashed with liquid flashing materials.

G. Small Penetration Condition:
   1. Small Penetration (6" dia. or less): Liquid flashing with sealant in a cove joint sealing penetration to surface face of structural insulating sheathing.

H. At Grade and Below Grade:
   1. Use only manufacturer approved below grade materials capable of withstanding constant hydrostatic water pressure. Materials must be specifically labeled for Below Grade use.

3.06 ADJUSTING

A. Cutting and Fitting: Cut and fit for chases, pipes, conduit, sleeves and grounds. Coordinate with other sections of work to provide correct size, shape and location. Maximum 1/8" gap. Seal gap with appropriate sealant per location requirements.

3.07 FIELD QUALITY CONTROL/ TOLERANCES

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Perform field quality control inspection as specified in Part 1, Quality Assurance.

3.08 TOLERANCE

A. Joint thickness: No gaps greater than ¼ inch allowed without installation of supplemental low rise field applied foam insulation and backer rod for sealants.

3.09 PROTECTION

A. During erection, cover top of walls with waterproof sheeting at end of each work day. Cover partially completed walls when work is not in progress.

B. Do not leave factory coated air and water resistive barrier surfaces exposed to weather longer than one hundred eighty (180) days without approval from manufacturer.

C. Structural Insulating Sheathing boards without a factory applied air and water barrier shall be covered within sixty (60) days after installation.

D. Do not permit installed materials to be damaged prior to concealment.

END OF SECTION

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SECTION 06 20 00
FINISH CARPENTRY

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes the following:
   1. Interior standing and running trim.
   2. Hardwood Veneer Plywood paneling.
   3. Exterior Wood Siding.

1.02 RELATED SECTIONS

A. Section 01 33 00 - Submittal Procedures.

B. Section 01 40 00 - Quality Requirements.

C. Section 01 60 00 - Product Requirements.

D. Section 06 10 00 - Rough Carpentry.

E. Section 06 15 00 - Wood Decking.

F. Section 06 20 01 - Finish Carpentry Schedule.

G. Section 06 40 00 - Architectural Woodwork.

H. Section 09 74 16 - Wood Veneer Wall Covering.

1.03 REFERENCE STANDARDS

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; Current Edition.

B. ANSI A135.4 - Basic Hardboard; 2012 (Reaffirmed 2020).

C. ANSI A208.1 - American National Standard for Particleboard; 2022.

D. ANSI A208.2 - Medium Density Fiberboard (MDF) for Interior Applications; 2022.

E. ASTM D3498 - Standard Specification for Adhesives for Field-Gluing Wood Structural Panels (Plywood or Oriented Strand Board) to Wood Based Floor System Framing; 2019a.

F. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood; 2020.

G. PS 1 - Structural Plywood; 2023.

H. PS 20 - American Softwood Lumber Standard; 2025.

I. SCAQMD 1168 - Adhesive and Sealant Applications; 1989, with Amendment (2022).

1.04 DEFINITIONS

A. Lumber grading agencies, and the abbreviations used to reference them, include the following:
   1. NHLA: National Hardwood Lumber Association.
   2. NLGA: National Lumber Grades Authority.

B. MDF: Medium-density fiberboard.

C. MDO Plywood: Plywood with a medium-density overlay on the face.

1.05 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00.

1.06 SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials, dimensions, profiles, textures, and colors and include construction and application details.

B. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.

2. Submit inventory to Owner within 5 days of delivery of materials.
3. See Sections 01 33 00 and 01 60 00.

C. Research/Evaluation Reports: Showing that fire-retardant-treated wood complies with building code in effect for Project.

D. Warranty: Special warranty specified in this Section.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect materials against weather and contact with damp or wet surfaces. Stack lumber, plywood, and other panels flat with spacers between each bundle to provide air circulation. Provide for air circulation within and around stacks and under temporary coverings.

B. Deliver interior finish carpentry materials only when environmental conditions meet requirements specified for installation areas. If interior finish carpentry materials must be stored in other than installation areas, store only where environmental conditions meet requirements specified for installation areas.

1.08 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install interior finish carpentry materials until building is enclosed and weatherproof, wet work in space is completed and nominally dry, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Do not install finish carpentry materials that are wet, moisture damaged, or mold damaged.
1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 PRODUCTS

2.01 MATERIALS, GENERAL

A. Lumber: DOC PS 20 and applicable grading rules of inspection agencies certified by ALSC's Board of Review.

B. Softwood Plywood: DOC PS 1.

C. Hardboard: AHA/ANSI A135.4.

D. MDF: ANSI A208.2, Grade 130.

E. Particleboard: ANSI A208.1, Grade M-2.

F. VOC Limits for Installation Adhesives and Glues: Use installation adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
1. Wood Glues: 30 g/L.
2. Contact Adhesive: 250 g/L.F.

G. Low-Emitting Materials:
1. Provide composite wood products containing no added urea formaldehyde.
2. Adhesives applied on site shall comply with South Coast Air Quality Management District SCAQMD 1168.

2.02 STANDING AND RUNNING TRIM

A. Hardwood Lumber Moldings and Trim for Transparent Finish (Stain or Clear Finish):
1. Species and Grade: White maple; Clear; NHLA.
2. Maximum Moisture Content: 6 percent.
3. Finger Jointing: Not allowed.
4. Gluing for Width: Use for lumber trim wider than 6 inches (150 mm).
5. Veneered Material: Allowed.
6. Face Surface: Surfaced (smooth).

7. Matching: Selected for compatible grain and color.

2.03 PANELING

A. Hardwood Veneer Plywood Paneling: Manufacturer's stock hardwood plywood panels complying with HPVA HP-1, made without urea-formaldehyde adhesive.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Dooge Veneers Inc.
      b. Georgia-Pacific Corp.
      c. RS Bacon Veneer Company.
   2. Face Veneer Species and Cut: White Maple plain cut.
   3. Veneer Matching: Selected for similar color and grain.
   4. Backing Veneer Species: Any hardwood compatible with face species.
   5. Construction: Veneer core.
   6. Thickness: 1/16 inch (1.6 mm).
   7. Panel Size: 48 by 96 inches (1219 by 2438 mm).
   8. Glue Bond: Type II (interior).
   9. Face Pattern: Manufacturer's standard-grooved pattern, with grooves at edges, center, and third points of panels, and at other locations to provide pattern resembling random width boards.
   10. Finish: Manufacturer's standard, transparent, UV-resistant, protective finish.

B. See attached Finish Carpentry Schedule.

2.04 EXTERIOR WOOD SIDING

A. Basis of Design: Mataverde Premium Hardwood Siding, email sales@mataverdecking.com; web www.mataverdecking.com.
   1. Hardwood Siding:
      a. Species: Ipe
      b. Face: 4 7/8"
      c. Gap: 1/8"

2.05 MISCELLANEOUS MATERIALS

A. Fasteners for Interior Finish Carpentry: Nails, screws, and other anchoring devices of type, size, material, and finish required for application indicated to provide secure attachment, concealed where possible.

B. Paneling Adhesive: Comply with paneling manufacturer's written recommendations for adhesives.
   1. Use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Multipurpose Construction Adhesive: Formulation complying with ASTM D3498 that is recommended for indicated use by adhesive manufacturer.
   1. Use adhesive that has a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Plywood backing: Behind all wood panels in lieu of gypsum board. See Section 06 10 00.

E. VOC Limits for Installation Adhesives and Glues: Use installation adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
   1. Wood Glues: 30 g/L.
   2. Contact Adhesive: 250 g/L.

2.06 FABRICATION

A. Fabricators: Subject to compliance with requirements, provide finish carpentry by the following:
   1. LTF Millwork, 4200 Norex Drive, Chaska, MN 55318. Phone: (952) 229-7647, Fax: (952) 477-5972.

B. Back out or kerf backs of the following members except those with ends exposed in finished work:

1. Interior standing and running trim except shoe and crown molds.
2. Wood board paneling.

C. Ease edges of lumber less than 1 inch (25 mm) in nominal thickness to 1/16-inch (1.5-mm) radius and edges of lumber 1 inch (25 mm) or more in nominal thickness to 1/8-inch (3-mm) radius.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine finish carpentry materials before installation. Reject materials that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Clean substrates of projections and substances detrimental to application.

B. Before installing interior finish carpentry, condition materials to average prevailing humidity in installation areas for a minimum of 24 hours.

3.03 INSTALLATION, GENERAL

A. Do not use materials that are unsound, warped, improperly treated or finished, inadequately seasoned, or too small to fabricate with proper jointing arrangements.

B. Install interior finish carpentry level, plumb, true, and aligned with adjacent materials. Use concealed shims where necessary for alignment.
1. Scribe and cut interior finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.
2. Countersink fasteners, fill surface flush, and sand where face fastening is unavoidable.
3. Install to tolerance of 1/8 inch in 96 inches (3 mm in 2438 mm) for level and plumb. Install adjoining interior finish carpentry with 1/32-inch (0.8-mm) maximum offset for flush installation and 1/16-inch (1.5-mm) maximum offset for reveal installation.

3.04 STANDING AND RUNNING TRIM INSTALLATION

A. Install with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than 24 inches (610 mm) long, except where necessary. Stagger joints in adjacent and related standing and running trim. Cope at returns and miter at corners to produce tight-fitting joints with full-surface contact throughout length of joint. Use scarf joints for end-to-end joints. Plane backs of casings to provide uniform thickness across joints where necessary for alignment.
1. Install trim after gypsum board joint finishing operations are completed.
2. Drill pilot holes in hardwood before fastening to prevent splitting. Fasten to prevent movement or warping. Countersink fastener heads on exposed carpentry work and fill holes.

3.05 PANELING INSTALLATION

A. Plywood Paneling: Select and arrange panels on each wall to minimize noticeable variations in grain character and color between adjacent panels. Leave 1/4-inch (6-mm) gap to be covered with trim at top, bottom, and openings. Install with uniform tight joints between panels.
1. Attach panels to supports with manufacturer's recommended panel adhesive and fasteners. Space fasteners as recommended by panel manufacturer.
2. Conceal fasteners to greatest practical extent.

3.06 ADJUSTING

A. Replace interior finish carpentry that is damaged or does not comply with requirements. Interior finish carpentry may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing. Adjust joinery for uniform appearance.

3.07 CLEANING

A. Clean interior finish carpentry on exposed and semiexposed surfaces. Touch up factory-applied finishes to restore damaged or soiled areas.

3.08 PROTECTION

A. Protect installed products from damage from weather and other causes during remainder of the construction period.

B. Remove and replace finish carpentry materials that are wet, moisture damaged, and mold damaged.
   1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
   2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

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SECTION 06 20 01
FINISH CARPENTRY SCHEDULE

PART 1 GENERAL

PART 2 PRODUCTS

2.01 MATERIALS

A. MDF-1
   1. Manufacturer: Soelberg Industries
   2. Collection: Colonna
   3. Finish: Umbra Matte
   4. Core: 3/4” MDF Core
   5. Size: 48” x 96”
   6. Vendor: Soelberg Industries
      a. Contact name: Ryan Colvin
      b. Phone: 952-913-8822
      c. Email: ryan@soelbergi.com
   7. URL: https://soelbergi.com/3d-wall-panels/colonna/

B. WDP-2
   1. Manufacturer: DuChateau
   2. Product: Crest
   3. Size: 7 1/4” x 25 3/8”
   4. Collection: Inceptiv
   5. Species: American Walnut
   6. Thickness: 3/16"
   7. Vendor: Dream Floors.
      a. Contact name: Davron Gafurov
      b. Phone: 763-746-6666
      c. Email: davron@dreamfloors.net
   8. NOTE: 8 week lead time on all DuChateau products, not including shipping
   9. URL: https://duchateau.com/product/crest/

C. WDP-4
   1. Manufacturer: DuChateau
   2. Product: Kuadra
   3. Size: 7 3/8" x 31 1/4"
   4. Collection: Inceptiv
   5. Species: American Walnut
   6. Thickness: 11/16"
   7. Vendor: Dream Floors
      a. Contact name: Davron Gafurov
      b. Phone: 763-746-6666
      c. Email: davron@dreamfloors.net
   8. NOTE: 8 week lead time on all DuChateau products, not including shipping
   9. URL: https://duchateau.com/product/kuadra/

D. WDP-5
   1. Manufacturer: Plyboo
   2. Product: Reveal Collection Amber Edge Grain
   3. Panel Style: C9; Real Core Technology Prefinished
   4. Species: Bamboo
   5. Size: 48" x 96"
   6. Thickness: 3/4"
   7. Vendor: Intectural

a. Contact name: Kelly Bartz (M)
b. Phone: 218-336-8579
c. Email: kelly@intectural.com

8. NOTE: 3-4 week lead time on Plyboo products, not including shipping
9. URL: https://www.plyboo.com/plyboodirect/the-reveal-collection-style-c9.html

E. WDP-7
1. Manufacturer: Stacked Wood
2. Product: Real Wood Decorative Wall Panel
3. Product #: 2012
4. Pattern: Maisie
5. Color: Juglans (Walnut)
6. Finish: Varnish 10% Gloss
7. Panel Size: 14" x 57"
8. Thickness: 0.28-0.35"
9. Coverage: 22sqft per case
10. Vendor: Design Resource - Midwest 612.374.9006
11. URL: https://www.stackedwoodwalls.com/maisie/juglans

F. WDP-8
1. Manufacturer: DuChateau
2. Product: Edge
3. Size: 7 3/8" x 31 1/4"
4. Collection: Inceptiv
5. Species: American Walnut
6. Thickness: 15/16"
7. Trim: By manufacturer, see details.
8. Vendor: Dream Floors.
   a. Contact name: Davron Gafurov
   b. Phone: 763-746-6666
   c. Email: davron@dreamfloors.net
9. NOTE: 8 week lead time on all DuChateau products, not including shipping
10. URL: https://duchateau.com/product/edge/

G. WDP-9
1. Manufacturer: Soelberg
2. Collection: Raggio,custom finish by Millwork
3. Finish: Custom by millwork (VN-11)
4. Core: 3/4 Baltic Birch
5. Size: 48” x 96”
6. Vendor: Soelberg Industries
   a. Contact name: Jimmy Coray
   b. Phone: 801-877-5412
   c. Email: jimmy@soelbergi.com
7. URL: https://soelbergi.com/natura/raggio/

H. WDP-11
1. Manufacturer: Acoustical Art Concepts
2. Product: Akupanel
3. Size: 1” x .25”
4. Panel Size: 96” x 23.58”
5. Thickness: .866"
6. Material: PET Polyester Fiber, MDF, Wood Veneer
7. Color: Brown Oak
8. NRC: 0.97

9. Location: Café ceiling, elevator lobby
10. URL: https://acousticalartconcepts.com/akupanel-1x025

I. WDP-12A
1. Manufacturer: Surfacing Solution
2. Collection: Tambour
3. Profile: T374
4. Species: Poplar
5. Finish: Primed for field paint.
6. Size: See drawings.
7. URL: https://www.surfacingsolution.com/tambour

J. WDP-12B
1. Manufacturer: Surfacing Solution
2. Collection: Tambour
3. Profile: T374
4. Species: Walnut
5. Finish: Clear
6. Size: See drawings.
7. URL: https://www.surfacingsolution.com/tambour

END OF SECTION

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SECTION 06 40 00
ARCHITECTURAL WOODWORK

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes the following:
   1. Wood cabinets.
   2. Hardware.
   3. Plastic-laminate countertops.
   4. Shop finishing of interior woodwork.
   5. Millwork Trim.

1.02 RELATED SECTIONS

A. Section 01 33 00 - Submittal Procedures.

B. Section 01 40 00 - Quality Requirements.

C. Section 01 60 00 - Product Requirements.

D. Section 06 10 00 - Rough Carpentry.

E. Section 06 15 00 - Wood Decking.

F. Section 06 20 00 - Finish Carpentry.

G. Section 06 40 01 - Architectural Woodwork Schedules.

H. Section 09 74 16 - Flexible Wood Veneer Wall Covering.

I. Section 09 91 00 - Painting.

1.03 REFERENCE STANDARDS

A. AHA A135.4 American Hardboard Association; Basic Hardboard.

B. ANSI A208.2 - Medium Density Fiberboard (MDF) for Interior Applications; 2022.

C. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.

D. ASTM D523 - Standard Test Method for Specular Gloss; 2014 (Reapproved 2018).

E. AWI (QCP) - Quality Certification Program; Current Edition.

F. AWI/AWMAC/WI - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).

G. BHMA A156.9 - Cabinet Hardware; 2020.

H. BHMA A156.11 - American National Standard for Cabinet Locks; 2019.

I. BHMA A156.18 - Standard for Materials and Finishes; 2020.

J. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood; 2020.

K. ASLS DOC PS 20 American Softwood Lumber Standard.

L. AWPA U1 User Specification for Treated Wood.

M. NEMA LD 3 ANSI/NEMA Standard for High Pressure Laminates.

1.04 DEFINITIONS

A. Architectural woodwork includes wood furring, blocking, shims, and hanging strips for installing woodwork items unless concealed within other construction before woodwork installation.

1.05 SUBMITTALS

A. Product Data: For each type of product indicated, including cabinet hardware and accessories and finishing materials and processes.

B. Product Data: For high-pressure decorative laminate and adhesive for bonding plastic laminate.

C. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

1. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
2. Show locations and sizes of cutouts and holes for plumbing fixtures and other items installed in architectural woodwork.

D. Samples for Verification:
1. Lumber with or for transparent finish, not less than 50 sq. in. (300 sq. cm), for each species and cut, finished on 1 side and 1 edge.
2. Veneer-faced panel products with or for transparent finish, 8 by 10 inches (200 by 250 mm), for each species and cut. Include at least one face-veneer seam and finish as specified.
3. Plastic laminates, 8 by 10 inches (200 by 250 mm), for each type, color, pattern, and surface finish, with 1 sample applied to core material and specified edge material applied to 1 edge.

E. Procurement:
1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
2. Submit inventory to Owner within 5 days of delivery of materials.
3. See Sections 01 33 00 and 01 60 00.

F. Product Certificates: For each type of product, signed by product manufacturer.

G. Woodwork Quality Standard Compliance Certificates: AWI (QCP) Quality Certification Program certificates.

1.06 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a certified participant in AWI (QCP) Quality Certification Program.

C. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production of architectural woodwork with sequence-matched wood veneers.

D. Quality Standard: Unless otherwise indicated, comply with AWI/AWMAC/WI "Architectural Woodwork Quality Standards" for grades of architectural woodwork indicated for construction, finishes, installation, and other requirements.

E. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

F. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.07 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

1.08 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F (16 and 32 deg C) and relative humidity at occupancy levels during the remainder of the construction period.

C. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
   1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.
   2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating woodwork without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.09 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that architectural woodwork can be supported and installed as indicated.

PART 2 PRODUCTS

2.01 WOODWORK FABRICATORS

A. Cabinet Fabricators: Subject to compliance with requirements, provide architectural woodwork by the following:
   1. LTF Millwork, 4200 Norex Drive, Chaska, MN 55318. Phone: (952) 229-7647, Fax: (952) 477-5972.
   2. Approved Equal.

2.02 MATERIALS

A. General: Provide materials that comply with requirements of AWI's quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.

B. Wood Species and Cut for Transparent Finish: Maple, Select White, plain cut.

C. Wood Products: Comply with the following:
   1. Hardboard: AHA A135.4.
   2. Medium-Density Fiberboard: ANSI A208.2, Grade MD, made with binder containing no urea formaldehyde.
   3. Softwood Plywood: DOC PS 1.
   4. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1, made with adhesive containing no urea formaldehyde.
      a. Manufacturer: Subject to compliance with requirements, provide veneer-faced panel by one of the following:
         1) Dooge Veneers, 485 Airwest, SE, Grand Rapids, MI 49512. Telephone: 616.698.6540.
         2) RS Bacon Veneer Company, 100 South Mannheim Road, Hillside, IL 60162. Telephone: 708.547.6673

D. Wood Veneers & Stains:
   1. See attached Schedule.

E. High-Pressure Decorative Laminate:
   1. See attached Schedule.

F. Tempered Float Glass for Cabinet Doors: ASTM C1048, Kind FT, Condition A, Type I, Class 1 (clear), Quality-Q3, 6 mm thick, unless otherwise indicated.

G. Permalam, Almond Melamine at Cabinet Interior.

2.03 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets, except for items specified in Division 8 Section "Door Hardware (Scheduled by Describing Products)."
   1. Refer to Millwork for casework hardware materials.

2.04 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

C. Adhesives, General: Do not use adhesives that contain urea formaldehyde.

D. Adhesive for Bonding Plastic Laminate: Contact cement.

2.05 FABRICATION, GENERAL

A. Interior Woodwork Grade: Unless otherwise indicated, provide Premium-grade interior woodwork complying with referenced quality standard.

B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.

C. Fabricate woodwork to dimensions, profiles, and details indicated.

D. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

E. Shop-cut openings to maximum extent possible to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
   1. Seal edges of openings in countertops with a coat of varnish.

F. Install glass to comply with applicable requirements in Division 8 Section "Glazing" and in GANA's "Glazing Manual." For glass in wood frames, secure glass with removable stops.

2.06 WOOD CABINETS FOR TRANSPARENT FINISH

A. Grade: Premium.

B. AWI Type of Cabinet Construction: Flush overlay.

C. Wood Species and Cut for Exposed Surfaces: Maple, plain sliced.
   1. Grain Direction: Horizontally for drawer fronts, doors, and fixed panels.
   2. Matching of Veneer Leaves: Slip match.
   3. Vertical Matching of Veneer Leaves: End match.
   4. Veneer Matching within Panel Face: Running match.
   5. Comply with veneer and other matching requirements indicated for blueprint-matched paneling.

2.07 PLASTIC-LAMINATE COUNTERTOPS

A. Grade: Premium.

B. High-Pressure Decorative Laminate Grade: HGP.

C. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
   1. Solid colors, matte finish.
   2. Solid colors with core same color as surface, matte finish.
   3. Wood grains, matte finish.
   4. Patterns, matte finish.

D. Edge Treatment: Same as laminate cladding on horizontal surfaces.

E. Core Material: Particleboard or medium-density fiberboard.

F. Core Material at Sinks: Particleboard made with exterior glue.

G. Paper Backing: Provide paper backing on underside of countertop substrate.

2.08 SHOP FINISHING

A. Grade: Provide finishes of same grades as items to be finished.

B. General: Finish architectural woodwork at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.

C. Transparent Finished Millwork:
   1. Shop apply the prime coat including back-priming, if any, for transparent-finished items specified to be field finished. Refer to Division 9 painting Sections for material and application requirements.
   2. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural woodwork, as applicable to each unit of work.
      a. Back-priming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to back of paneling and to end-grain surfaces. Concealed surfaces of plastic-laminate-clad woodwork do not require back-priming when surfaced with plastic laminate, backing paper, or thermoset decorative panels.
   3. Transparent Finish:
      a. Grade: Premium.
      b. AWI Finish System: TR-6, Catalyzed polyester.
      c. Staining: Match approved sample for color.
      d. Wash Coat for Stained Finish: Apply wash-coat sealer to woodwork made from closed-grain wood before staining and finishing.
         1) Apply wash-coat sealer after staining and before filling.
      e. Sheen: Satin, 31-45 gloss units measured on 60-degree gloss meter per ASTM D523.

D. Painted Millwork:
   1. Prime coat and first paint coat shall be shop applied.
   2. Final coats to be field applied by painter.
   3. See Section 09 91 00 - Painting.

PART 3 EXECUTION

3.01 PREPARATION

A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas.

B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and back-priming.

3.02 INSTALLATION

A. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.

B. Assemble woodwork and complete fabrication at Project site to comply with requirements for fabrication in Part 2, to extent that it was not completed in the shop.

C. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).

D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.

F. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.

1. Install cabinets with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.
2. Maintain veneer sequence matching of cabinets with transparent finish.

G. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
1. Install countertops with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.
2. Secure backsplashes to walls with adhesive.
3. Caulk space between backsplash and wall with sealant specified in Division 7 Section "Joint Sealants."

H. Touch up finishing work specified in this Section after installation of woodwork. Fill nail holes with matching filler where exposed.

3.03 ADJUSTING AND CLEANING

A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean woodwork on exposed and semi-exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION

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SECTION 06 40 01
ARCHITECTURAL WOODWORK SCHEDULES

PART 1 GENERAL

PART 2 PRODUCTS

2.01 MATERIALS

A. Wood Veneers & Stains:
   1. VN-3:
      a. Manufacturer: By owner's millwork vendor
      b. Species: Walnut
      c. Stain: Custom stain to match PLAM-35.
      d. Location: As required.
   2. VN-13
      a. Manufacturer: By owner's millwork vendor
      b. Species: Walnut
      c. Stain: Custom stain to match PLAM-34.
      d. Location: Flush Wood Doors, Locker room benches

B. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard.
   1. Manufacturer: Subject to compliance with requirements, provide high-pressure decorative laminates by one of the following:
      a. PLAM-19:
         1) Manufacturer: Wilsonart
         2) Collection: Fine Velvet Texture Finish
         3) Color: Neowalnut 7991-38
         4) Location: Toilet Partitions
         5) URL: https://www.wilsonart.com/neowalnut-7991-8994c244f80553bd89a07a29115f812d
      b. PLAM-33:
         1) Manufacturer: Wilsonart
         2) Collection: Contract Collection
         3) Color: Natural Almond
         4) Location: Interior finish of select LTKA casework
         5) URL: https://www.wilsonart.com/natural-almond-d30
      c. PLAM-34:
         1) Manufacturer: Egger
         2) Color: #H3710-ST22 Natural Carini Walnut
         3) Finish: ST22-Textured Finish
         4) Location: Millwork Throughout, UNO
         5) URL: https://www.egger.com/shop/en_US/interior/decor-detail/H3710_12
      d. PLAM-35:
         1) Manufacturer: Egger
         2) Color: #H3794-ST12 Chocolate Carini Walnut
         3) Finish: H3794 ST12
         4) Location: As indicated in Spa Area
         5) https://www.egger.com/shop/en_US/interior/decor-detail/H3794_12

END OF SECTION

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SECTION 06 64 00
PLASTIC PANELING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes glass-fiber reinforced plastic wall paneling and trim accessories and Thermoplastic Resin Panels.

1.02 RELATED SECTIONS

A. Section 01 33 00 - Submittal Procedures.

B. Section 01 40 00 - Quality Requirements.

C. Section 01 60 00 - Product Requirements.

D. Section 06 20 00 - Finish Carpentry.

E. Section 06 40 00 - Architectural Woodwork.

F. Section 06 64 01 - Plastic Panelling - Schedules.

G. Section 09 21 16 - Gypsum Board Assemblies.

1.03 REFERENCE STANDARDS

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; Current Edition.

B. ASTM D5319 - Standard Specification for Glass-Fiber Reinforced Polyester Wall and Ceiling Panels; 2022.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

1.04 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.
   3. See Sections 01 33 00 and 01 60 00.

1.05 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Source Limitations: Obtain plastic paneling and trim accessories from single manufacturer.

C. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Flame-Spread Index: 25 or less.
   2. Smoke-Developed Index: 450 or less.
   3. Testing Agency: UL.

1.06 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install plastic paneling until spaces are enclosed and weathertight and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 PRODUCTS

2.01 PLASTIC SHEET PANELING

A. Surface Burning Requirements, Interior Use: Flame spread index of 25 or less and smoke-development index of 450 or less; Class A classification when tested in accordance with ASTM E84.

B. Applicable panels must comply with the requirements of ASTM D5319.

C. See attached Schedule.

2.02 ACCESSORIES

A. Trim Accessories: Manufacturer's standard one-piece vinyl extrusions designed to retain and cover edges of panels. Provide division bars, inside corners, outside corners, and caps as needed to conceal edges.
   1. Color: Match panels.

B. Concealed Mounting Splines: Continuous, H-shaped aluminum extrusions designed to fit into grooves routed in edges of factory-laminated panels and to be fastened to substrate.

C. Adhesive: As recommended by plastic paneling manufacturer.
   1. VOC Content: 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Sealant: Single-component, mildew-resistant, neutral-curing silicone sealant recommended by plastic paneling manufacturer and complying with requirements in Division 7 Section "Joint Sealants."
   1. VOC Content: 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Prepare substrate by sanding high spots and filling low spots as needed to provide flat, even surface for panel installation.

B. Clean substrates of substances that could impair bond of adhesive, including oil, grease, dirt, and dust.

C. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.

D. Lay out paneling before installing. Locate panel joints to provide equal panels at ends of walls not less than half the width of full panels.
   1. Mark plumb lines on substrate at panel joint locations for accurate installation.
   2. Locate panel joints to allow clearance at panel edges according to manufacturer's written instructions.

3.03 INSTALLATION

A. Install plastic paneling according to manufacturer's written instructions.

B. Install panels in a full spread of adhesive.

C. Install trim accessories with adhesive. Do not fasten through panels.

D. Fill grooves in trim accessories with sealant before installing panels and bed inside corner trim in a bead of sealant.

E. Maintain uniform space between panels and wall fixtures. Fill space with sealant.

F. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths until no residue remains.

G. Resin panels may be set in the storefront frame by excluding the glazing gasket and securing with sealant.

END OF SECTION

SECTION 06 64 01
PLASTIC PANELING SCHEDULE

PART 1 GENERAL

PART 2 PRODUCTS

2.01 PLASTIC SHEET PANELING

A. FRP-1: Gelcoat-finished, glass-fiber reinforced plastic panels complying with ASTM D 5319.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Glasbord by Crane Composites.
      b. Marlite
      c. Nudo Products, Inc
   2. Nominal Thickness: Not less than 0.09 inch (2.3 mm)
   3. Fire resistance: Provide Class C panels in sprinklered areas, Class A where there are no fire sprinklers.
   4. Height: Ten foot panels
   5. Surface Finish: Molded pebble texture
   6. Color: White

PART 3 EXECUTION

END OF SECTION

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SECTION 07 08 00
COMMISSIONING OF THERMAL AND MOISTURE PROTECTION

PART 1 GENERAL

1.01 SUMMARY

A. This section includes specific requirements that apply to the implementation of the Commissioning Process and this Division Contractors' participation in this process. This section details the project specific equipment and systems that are included in the Commissioning Process. For general descriptions and responsibilities, refer to SECTION 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

1.02 RELATED DOCUMENTS

A. The Owner's Project Requirements (OPR) document.

B. The Basis of Design (BoD) document.

C. The Project Commissioning Plan (CxP) document.

D. ASHRAE Standard 202-2013 - Commissioning Process for Buildings and Systems.

1.03 RELATED SECTIONS

A. SECTION 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS

B. SECTION 08 08 00 - COMMISSIONING OF OPENINGS

C. SECTION 11 08 00 - COMMISSIONING OF EQUIPMENT

D. SECTION 13 08 00 - COMMISSIONING OF SPECIAL CONSTRUCTION

E. SECTION 14 08 00 - COMMISSIONING OF CONVEYING SYSTEMS

F. SECTION 21 08 00 - COMMISSIONING OF FIRE SUPPRESSION SYSTEMS

G. SECTION 22 08 00 - COMMISSIONING OF PLUMBING SYSTEMS

H. SECTION 23 08 00 - COMMISSIONING OF MECHANICAL SYSTEMS

I. SECTION 25 08 00 - COMMISSIONING OF INTEGRATED AUTOMATION SYSTEMS

J. SECTION 26 08 00 - COMMISSIONING OF ELECTRICAL SYSTEMS

K. SECTION 27 08 00 - COMMISSIONING OF COMMUNICATIONS SYSTEMS

L. SECTION 28 08 00 - COMMISSIONING OF SAFETY AND SECURITY SYSTEMS

M. SECTION 33 08 00 - COMMISSIONING OF UTILITIES

1.04 DEFINITIONS

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

1.05 RESPONSIBILITIES

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

PART 2 PRODUCTS

2.01 NO PRODUCTS SUPPLIED

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

B. Contractors and/or Vendors shall provide the specialty testing equipment necessary to fulfill the functional testing requirements, for the duration of the testing period.

PART 3 EXECUTION

3.01 GENERAL

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.02 MEETINGS

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.03 SYSTEM START-UP

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.04 PRE-FUNCTIONAL CHECKLISTS

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.05 FUNCTIONAL PERFORMANCE TESTING

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.06 TRAINING

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.07 SYSTEMS TO BE COMMISSIONED

A. GENERAL
   1. Commissioning specifications supplement the requirements of individual specifications sections but shall not be interpreted to replace or diminish the specified scope of any individual section.
   2. For all systems listed below, Division Contractor shall comply with all commissioning requirements specified.

B. APPLICABLE SYSTEMS
   1. Fluid Applied Waterproofing Membrane
   2. Thermal Insulation
   3. Exterior Insulation and Finish System
   4. Fluid-Applied Membrane Air Barrier
   5. Metal Wall Panels
   6. Thermoplastic Polyolefin Roofing
   7. Sheet Metal Flashing and Trim
   8. Applied Fireproofing
   9. Intumescent Fireproofing
   10. Board Fireproofing
   11. Fire Stopping
   12. Joint Sealants
   13. Expansion Joint Systems

END OF SECTION

SECTION 07 13 25
SELF-ADHERING (POST-APPLIED) SHEET WATERPROOFING

PART 1 — GENERAL

1.01 SUMMARY

A. The work of this section includes, but is not limited to, the following:
   1. Rubberized asphalt sheet membrane waterproofing – Two types.
   2. Prefabricated drainage composite
   3. Protection board

B. Related Sections: Other specification sections which directly relate to the work of this section include, but are not limited to, the following:
   1. Section 033000 – Cast-In-Place Concrete
   2. Section 042000 – Unit Masonry
   3. Section 071100 – Dampproofing
   4. Section 076000 – Flashing and Sheet Metal
   5. Section 079200 – Joint Sealants
   6. Section 079500 – Expansion Control
   7. Section 334600 – Subdrainage

1.02 SUBMITTALS

A. Product Data: Submit manufacturer's product data, installation instructions, use limitations and recommendations. Include certification of data indicating VOC (Volatile Organic Compound) content of all components of waterproofing system.

B. Samples: Submit representative samples of the following for approval:
   1. Sheet membrane
   2. Protection board
   3. Prefabricated drainage composite

1.03 REFERENCE STANDARDS

A. The following standards and publications are applicable to the extent referenced in the text.

B. American Society for Testing and Materials (ASTM)
   C 836 Standard Specification for High Solids, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course
   D 412 Standard Test Methods for Rubber Properties in Tension
   D 570 Standard Test Method for Water Absorption of Plastics
   D 882 Standard Test Methods for Tensile Properties of Thin Plastic Sheeting
   D 903 Standard Test Method for Peel or Stripping Strength of Adhesive Bonds
   D 1876 Standard Test Method for Peel Release of Adhesives (T-Peel)
   D 1970 Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection
   D 3767 Standard Practice for Rubber - Measurements of Dimensions
   D 5385 Standard Test Method for Hydrostatic Pressure Resistance of Waterproofing Membranes
   E 96 Standard Test Methods for Water Vapor Transmission of Materials
   E 154 Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover

1.04 QUALITY ASSURANCE

A. Manufacturer: Sheet membrane waterproofing shall be manufactured and marketed by a firm with a minimum of 20 years experience in the production and sales of self-adhesive sheet membrane waterproofing. Manufacturers proposed for use but not named in these specifications shall submit evidence of ability to meet all requirements specified, and include a list of projects of similar design and complexity completed within the past 5 years.

B. Installer: A firm which has at least 3 years experience in work of the type required by this section.

C. Materials: For each type of material required for the work of this section, provide primary materials which are the products of one manufacturer.

D. Pre-Installation Conference: A pre-installation conference shall be held prior to commencement of field operations to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work. Agenda for meeting shall include review of special details and flashing.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver materials and products in labeled packages. Store and handle in strict compliance with manufacturer's instructions, recommendations and material safety data sheets. Protect from damage from sunlight, weather, excessive temperatures and construction operations. Remove damaged material from the site and dispose of in accordance with applicable regulations.

1. Do not double-stack pallets of membrane on the job site. Provide cover on top and all sides, allowing for adequate ventilation.

B. Sequence deliveries to avoid delays, but minimize on-site storage.

C. Safety and Handling

Users must read and understand the product label and Safety Data Sheets (SDS's) for each system component before use. All users must acquaint themselves with this information prior to working with the material. Carefully read detailed precaution statements on the product labels and SDS's before use.

1.06 PROJECT CONDITIONS

A. Perform work only when existing and forecasted weather conditions are within the limits established by the manufacturer of the materials and products used.

B. Proceed with installation only when substrate construction and preparation work is complete and in condition to receive sheet membrane waterproofing.

1.07 WARRANTY

A. Sheet Membrane Waterproofing: Provide written 5 year material warranty issued by the membrane manufacturer upon completion of the work.

PART 2 — PRODUCTS

2.01 MATERIALS

A. Sheet Membrane Waterproofing: BITUTHENE® 3000 Membrane/Low Temperature Membrane (BITUTHENE® System 4000 Membrane as required) as manufactured by GCP Applied Technologies; a self-adhesive, cold-applied composite sheet consisting of a thickness of 1.4 mm (0.056 in.) of rubberized asphalt and 0.1 mm (0.004 in.) of cross-laminated, high density polyethylene film. Provide rubberized asphalt membrane covered with a release sheet, which is removed during installation and no special adhesive or heat shall be required to form laps. Provide membrane with the following physical properties:

PHYSICAL PROPERTIES: BITUTHENE® 3000 Membrane & BITUTHENE® LOW TEMPERATURE Membrane

Property	Test Method	Typical Value
Color		Dark gray-black
Thickness	ASTM D 3767 Method A	1.5 mm (0.060 in.) nominal
Flexibility, 180° bend over 25 mm (1 in.) mandrel at -32°C (-25°F)	ASTM D 1970	Unaffected

Tensile Strength, Membrane Die C	ASTM D 412[1]	2240 kPa (325 psi) minimum
Tensile Strength, Film	ASTM D 882[1]	34.5 MPa (5,000 psi) minimum
Elongation, Ultimate Failure of Rubberized Asphalt	ASTM D 412[1]	300% minimum
Crack Cycling at -32°C (-25°F), 100 Cycles	ASTM C 836	Unaffected
Lap Shear	ASTM D 1002[2]	89 N (20 lbs) minimum
Peel Strength	ASTM D 903	1576 N/m (9 lbs/in.) minimum
Puncture Resistance, Membrane	ASTM E 154	222 N (50 lbs) minimum
Resistance to Hydrostatic Head	ASTM D 5385	>70 m (>230 ft) of water
Permeance	ASTM E 96, Section 12 – Water Method	<0.1 perms
Water Absorption	ASTM D 570	0.1% maximum

PHYSICAL PROPERTIES FOR BITUTHENE® SYSTEM 4000 MEMBRANE:

Property	Test Method	Typical Value
Color		Dark gray-black
Thickness	ASTM D 3767 Method A	60 mils (1.5 mm) nominal
Flexibility, 180° bend over 25 mm (1 in.) mandrel at -32°C (-25°F)	ASTM D 1970	Unaffected
Tensile Strength, Membrane Die C	ASTM D 412[1]	2240 kPa (325 psi) minimum
Tensile Strength, Film	ASTM D 882[1]	34.5 MPa (5,000 psi) minimum
Elongation, Ultimate Failure of Rubberized Asphalt	ASTM D 412[1]	300% minimum
Crack Cycling at -32°C (-25°F), 100 Cycles	ASTM C 836	Unaffected
Lap Shear	ASTM D 1002[2]	89 N (20 lbs.) minimum
Peel Strength	ASTM D 903	1926 N/m (11 lbs/in.) minimum
Puncture Resistance, Membrane	ASTM E 154	222 N (50 lbs.) minimum
Resistance to Hydrostatic Head	ASTM D 5385	>70 m (>230 ft) of water
Permeance	ASTM E 96, Section 12 – Water Method	<0.1 perms
Water Absorption	ASTM D 570	0.1% (maximum)

2.02 Ancillary Products

A. Prefabricated Drainage Composite: HYDRODUCT® 220 and/or HYDRODUCT® 660 Drainage Composite as manufactured by GCP Applied Technologies to promote positive drainage while serving as a protection course.

B. Protection Board:
   1. Expanded Polystyrene Protection Board: 25 mm (1 in.) thick for vertical applications with the following characteristics. Adhere to waterproofing membrane with BITUTHENE®Protection Board Adhesive.
      i. Normal Density: 16 kg/m^3 (1.0 lb/ft^3)
      ii. Thermal Conductivity, K factor: 0.24 at 5°C (40°F), 0.26 at 24°C (75°F)
      iii. Thermal Resistance, R-Value: 4 per 25 mm (1 in.) of thickness.
      iv. PSI: 25

2. Asphalt Hardboard: A premolded semi-rigid protection board consisting of bitumen, mineral core and reinforcement. Provide 3 mm (0.125 in.) thick hardboard on horizontal surfaces not receiving steel reinforced slab. Where steel reinforcing bars are to be used, apply two layers of 3 mm (0.125 in.) thick hardboard or one layer of 6 mm (0.25 in.) thick hardboard.

C. Waterstop: Adcor™ hydrophilic waterstop as manufactured by GCP Applied Technologies for non-moving concrete construction joints.

D. Miscellaneous Materials: Surface conditioner, mastic, liquid membrane, tape and accessories specified or acceptable to manufacturer of sheet membrane waterproofing.

PART 3 — EXECUTION

3.01 EXAMINATION

A. The installer shall examine conditions of substrates and other conditions under which this work is to be performed and notify the contractor, in writing, of circumstances detrimental to the proper completion of the work. Do not proceed with work until unsatisfactory conditions are corrected.

3.02 SUBSTRATE PREPARATION

A. Refer to manufacturer's literature for requirements for preparation of substrates. Surfaces shall be structurally sound and free of voids, spalled areas, loose aggregate and sharp protrusions. Remove contaminants such as grease, oil and wax from exposed surfaces. Remove dust, dirt, loose stone and debris. Use repair materials and methods which are acceptable to manufacturer of sheet membrane waterproofing.

B. Cast-In-Place Concrete Substrates:

1. Do not proceed with installation until concrete has properly cured and dried (minimum 7 days for normal structural concrete and minimum 14 days for lightweight structural concrete).
2. Fill form tie rod holes with concrete and finish flush with surrounding surface.
3. Repair bugholes over 13 mm (0.5 in.) in length and 6 mm (0.25 in.) deep and finish flush with surrounding surface.
4. Remove scaling to sound, unaffected concrete and repair exposed area.
5. Grind irregular construction joints to suitable flush surface.

C. Masonry Substrates: Apply waterproofing over concrete block and brick with smooth trowel-cut mortar joints or parge coat.

D. Wood Substrates: Apply waterproofing membrane over securely fastened sound surface. All joints and fasteners shall be flush to create a smooth surface.

E. Related Materials: Treat joints and install flashing as recommended by waterproofing manufacturer.

3.03 INSTALLATION

A. Refer to manufacturer's literature for recommendations on installation, including but not limited to, the following:

1. Apply primer at rate recommended by manufacturer. Recoat areas not waterproofed if contaminated by dust. Mask and protect adjoining exposed finish surfaces to protect those surfaces from excessive application of primer.
2. Delay application of membrane until primer is completely dry. Dry time will vary with weather conditions.
3. Seal daily terminations with troweled bead of mastic.
4. Apply protection board and related materials in accordance with manufacturer's recommendations.

3.04 CLEANING AND PROTECTION

A. Protect completed membrane waterproofing from subsequent construction activities as recommended by manufacturer.
B. Inspect for damage just prior to installation of subsequent construction activities and make repairs in accordance with manufacturer's recommendation.

END OF SECTION

SECTION 07 14 50
FLUID-APPLIED WATERPROOFING MEMBRANE

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. **Section included as an alternate to Section 07 13 25 – Self-Adhering (Post-Applied) Sheet Waterproofing.**
   2. Surface preparation of concrete surfaces, sealing of form ties, cracks, and joints for installation of fluid-applied waterproofing membrane.
   3. Provide fluid-applied waterproofing membrane, applicable sealants, drainage, and elastomeric flashings needed to prevent water penetration at locations indicated.
   4. Provide insulation board for protection of waterproofing membrane from damage during backfill.

1.02 RELATED SECTIONS

A. Section 01 33 00 - Submittal Procedures.

B. Section 01 40 00 - Quality Requirements.

C. Section 01 60 00 - Product Requirements.

D. Section 03 30 00 - Cast-In-Place Concrete.

E. Section 04 20 00 - Unit Masonry.

F. Section 06 10 00 - Rough Carpentry.

G. Section 07 21 00 - Thermal Insulation.

H. Section 07 54 23 - Thermoplastic Polyolefin (TPO) Roofing.

I. Section 07 62 00 - Sheet Metal Flashing and Trim.

J. Section 07 92 00 - Joint Sealers.

K. Section 09 21 16 - Gypsum Board Assemblies.

1.03 REFERENCE STANDARDS

A. ASTM C836/C836M Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course

B. ASTM C920 Standard Specification for Elastomeric Joint Sealants.

C. ASTM D903 Standard Test Method for Peel or Stripping Strength of Adhesive Bonds.

D. ASTM E96/E96M Standard Test Methods for Water Vapor Transmission of Materials.

E. ASTM E1966 Standard Test Method for Fire-Resistive Joint Systems.

1.04 LOCATIONS

A. Along Perimeter of building foundation walls, See Details.

B. Along backside of foundation walls, below elevation 100’- 0”, of Elevator Pit. Extend onto horizontal footing as shown on the drawings.

C. Along backside of foundation walls, below elevation 100”- 0”, of pool pump pits. Extend onto horizontal footing as shown on the drawings.

1.05 SUBMITTALS

A. Material and Equipment Submittals:
   1. Product Data: Submit fluid-applied waterproofing membrane and insulation board manufacturer's technical data.
      a. Include compatibility test reports for adjacent systems/ membranes that are in contact with each other.
   2. Samples: Submit samples of sealant colors for color selection.

3. Submit the results of the on-site adhesion testing. (Perform project specific adhesion testing of the water proofing membrane for all surfaces to receive membrane)
4. Site visit report from the waterproofing manufacture stating that they visited the site and inspected the substrates to receive new waterproofing and they found they are acceptable substrates.

B. Compatibility Letters:
1. Submit letters from the Manufacturer ensuring compatibility with adjacent materials, including Air Barrier, sealants, etc.

C. Procurement:
1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
2. Submit inventory to Owner within 5 days of delivery of materials.
3. See Sections 01 33 00 and 01 60 00.

D. Closeout Submittals:
1. Warranty. See below.

1.06 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Installers: Submit written statement from manufacturer that installer is certified to install the product.

C. Source limitations: All materials installed as part of waterproofing system shall be obtained from a single manufacturer, or consist of products certified by manufacturer as compatible.

D. Pre-Construction Conferences. The manufacturer will meet with the necessary parties at the jobsite to review and discuss project conditions as it relates to the integrity of the waterproofing assembly.

1.07 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to job site in manufacturer’s unopened containers with all labels intact and legible at time of use.

B. Maintain the products in accord with manufacturer’s recommendations with proper precautions to ensure fitness of materials when installed.

C. Protect waterproofing materials from freezing prior to application. Store material above 50 degrees.

D. Store rigid drainage, protection and insulation board flat and off the ground. Provide cover on top and on all sides.

1.08 SUBSTRATE CONDITIONS

A. General:
1. Provide surfaces that are broom clean, dry, sound and free of voids, bug holes, rock pockets, honeycombs, protrusions, excessive roughness, foreign matter, frost, ice and other contaminants which may inhibit application or performance of the waterproof membrane system.
2. Using suitable abrasive methods, remove residue of form release, curing compound, chemical retarders and other surface treatments, laitance, mortar smear, saw cutting residue, mill scale, rust, loose material and other contaminants from concrete, masonry and ferrous metal surfaces to receive the work of this Section.

B. Concrete: Where work of this Section will be applied to concrete, provide surfaces that are smooth finish equal to one that is light steel troweled followed by a fine hair broom.

1.09 WARRANTY

A. Deliver to the Architect signed copies of the following written warranties against defective materials and workmanship for a period of two years following date of completion. Warrant that installed waterproofing membrane system shall be free of defects including adhesive failure, cohesive failure, and waterproofing failure resulting from substrate cracking up to 1/16 inch.
1. Manufacturer’s standard warranty covering materials.

2. Applicator's standard warranty covering workmanship.

PART 2 PRODUCTS

2.01 MATERIALS

A. Single Source and compatibility requirements:
   1. Provide all components of the waterproofing system from a single source, with all components recommended by the Manufacturer for the application.
   2. Provide products that are certified by their Manufacturers to be compatible with adjacent materials.

B. Fluid-Applied Waterproofing Membrane, single component, Water based, polymer-modified asphalt emulsion. Acceptable Manufacturers and Products:
   1. Tremco: TREMproof 260 or 250GC.
   2. W.R. Meadows: MEL-ROLL LM
   3. Mar-Flex: ArmorMembrane 363
   4. Or approved equal.

2.02 ACCESSORIES

A. Joint Backing: Closed-cell, polyethylene rod as recommended by membrane manufacturer.

B. Joint Treatment: Provide a multi-component, chemically curing polyurethane sealant that is compatible with the provided membrane and recommended by its Manufacturer as being suitable for the application.
   1. Primer for sealant: Prime surface as recommended by the sealant manufacture.

C. Rigid Drainage, Protection, and Insulation Board:
   1. Dow Protection Board III.
   2. Or approved equal.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Coordinate as required with other trades to assure proper and adequate provision in the work of those trades for interface with the work of this Section.

B. Applicator shall examine areas and conditions under which Work of this Section will be performed:
   1. Verify conformance with manufacturer's requirements. Manufacture representative to visit site and approve prepared substrate. Letter from manufacture to be provided stating such.
   2. Report unsatisfactory conditions in writing to the Architect.
   3. Do not proceed until unsatisfactory conditions are corrected.

3.02 PREPARATION

A. Surface preparation and detailing procedures to be in accordance with waterproofing membrane system manufacturer's instructions and recommendations except where more stringent requirements are indicated.

B. On poured concrete walls, remove wall ties on outside and inside of wall. On poured concrete walls, tie holes and other voids, rock pockets, etc. shall be patched with a non-shrinking grout.

C. Clean surfaces to receive membrane system in accordance with manufacturer's instructions; vacuum clean or blow clean with oil-free compressed air all surfaces to receive sealants, detailing materials or membranes immediately prior to installation.

D. Rout, clean, prepare and detail surface cracks in accordance with manufacturer's instructions; install backer rod where required.

E. Install detail coats, joint and crack treatments, and liquid flashings in accordance with manufacturer's instructions.

F. Allow detail applications to cure in accordance manufacturer's instructions prior to general application of membrane.

3.03 APPLICATION

A. General: Install waterproofing system in accordance with manufacturer's recommendations and instructions as applies to the Work except where more stringent requirements are indicated.
   1. Waterproofing membrane shall have a 60 mil wet film thickness for vertical surfaces and 90 mil wet film thickness for horizontal surfaces.

B. Verify proper dry condition of substrate using method recommended by membrane system manufacturer; perform adhesion checks prior to general application of membrane system using field adhesion test method recommended by the manufacturer. Submit adhesion test results as called out in section 1.3 Part 3 of this specification section.

C. Mask off adjoining surfaces not to receive membrane system.

D. Clean all detail coats of Waterproof system from previous days' work with mineral spirit wipe. Wipe clean all other detail coats with Xylene solvent wipe; do not saturate detail coats. Overlap existing work by 6" with new work.

E. Apply membrane uniformly and allow cure in accord with manufacturer's instructions.

F. Tool joints to form smooth, uniform beads, with slightly concave surfaces. Do not use tooling agents, unless specifically recommended by sealant manufacturer.

G. Install protection course (drainage) over cured membrane in accordance with manufacturer's instructions.

3.04 PROTECTION AND CLEAN-UP

A. Promptly remove material of membrane system material from adjacent surfaces which will be exposed in the completed work. Leave work area in broom clean condition.

B. Prohibit traffic over completed work and against work overhead until protection course is installed; protect from damage until protected beneath overlaying work.

END OF SECTION

SECTION 07 18 00
TRAFFIC COATINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Waterproof coatings for traffic surfaces.
   1. TC-1: Epoxy Coating system.
   2. TC-2: Polyurethane Coating system.

1.02 RELATED REQUIREMENTS

A. Section 01 33 00 - Submittal Procedures.

B. Section 01 40 00 - Quality Requirements.

C. Section 01 60 00 - Product Requirements.

D. Section 03 30 00 - Cast-in-Place Concrete.

E. Section 09 05 61 - Common Work Results for Flooring Preparation.

F. Section 09 67 23 - Resinous Flooring

1.03 REFERENCE STANDARDS

A. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2016 (Reapproved 2021).

B. ASTM D903 - Standard Test Method for Peel or Stripping Strength of Adhesive Bonds; 1998 (Reapproved 2017).

C. ASTM D4060 - Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser; 2019.

D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

E. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2023.

F. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2022.

G. ICC-ES AC39 - Acceptance Criteria for Walking Decks; 2017, with Editorial Revision (2020).

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate work with Mechanical, Electrical and Aquatics.
   1. Sequence Traffic coating installation such that it is installed after the pouring of housekeeping pads and before floor mounted equipment in all areas to receive the coating.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Include product characteristics and limitations. Identify dissolving solvents, fuels, and potential destructive compounds.

C. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.
   3. See Sections 01 33 00 and 01 60 00.

D. Manufacturer's Installation Instructions: Include special field conditions required to install traffic membrane and potential incompatibilities with adjacent materials.

E. Maintenance Data: Include procedures for stain removal, repairing surface, and cleaning.

F. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with not less than three years of documented experience.

C. Applicator Qualifications: Company specializing in performing installation of traffic membrane, with minimum 3 years documented experience and approved by manufacturer.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Maintain storage area at minimum ambient temperature of 55 degrees F (13 degrees C).

B. Keep away from fire or open flame.

1.08 FIELD CONDITIONS

A. Do not install materials when temperature is below 50 degrees F (10 degrees C) or above 90 degrees F (32 degrees C).

B. Maintain this temperature range, 24 hours before, during and 72 hours after application.

C. Restrict traffic from area where materials are being installed or are curing.

1.09 WARRANTY

A. See Section 01 77 00 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 TRAFFIC COATINGS

A. **[TC-1]** Epoxy Coating System: 2-component, water based, epoxy-polyamide coating for concrete floors. VOC content, 121 g/L. Total Solids Content: 56 percent. Dry Film Thickness: 3-4 mils (76-102 microns) per coat. Apply 2 coats.
   1. Manufacturer/Product:
      a. The Euclid Chemical Co., "Eucopoxy Tufcoat VOX".
      b. Or approved equal.
   2. Non-Slip Aggregate Finish:
      a. Washed, dry, 70-90 mesh silica sand evenly into first coat.
   3. Finish: Smooth, semi-gloss.
   4. Color: As selected by Architect.

B. **[TC-2]** Pedestrian Polyurethane Waterproof Coating System: Fluid applied 2-part polyurethane system with base and top coat.
   1. Manufacturers/Product:
      a. Tremco Commercial Sealants & Waterproofing; Vulkem 350NF/351: www.tremcosealants.com/#sle.
      b. Or approved equal.
   2. Finished Coating Thickness: 48 mil, 0.048 inch (1.21 mm), minimum.
   3. Finish: Manufacturer's standard aggregate finish; particle sizes, shape, and minimum hardness recommended in writing by traffic-coating manufacturer.
   4. Color: As selected by Architect.

2.02 ACCESSORIES

A. Surfacing: Clean sand.

B. Filler and Primer: As recommended by membrane manufacturer.

C. Cant Strips: 1 inch by 1 inch (25.4 mm by 25.4 mm) by 45 degrees, of dense sponge rubber compatible with adjacent materials.

D. Sealant: As recommended by membrane manufacturer, and compatible with system and adjacent materials.

2.03 LIQUID SEALER / DENSIFIER

A. Silicone based sealer what penetrates concrete surfaces, and provides a "low-sheen" surface that is easy to clean and eases the problem of tire mark removal. Minimum solids content of 20%, with 50% siliconate.

B. Manufacturer/Product:
   1. Euclid Chemical Co., "Euco Diamond Hard".
   2. Substitutions: In accordance with Division 1 requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate is ready to receive work, surface is clean, dry and free of substances that could adversely effect bond.

B. Do not begin work until concrete substrate has cured at least 28 days and moisture content is 16 percent or less.

C. Test concrete surfaces according to ASTM F710 for acceptable level of alkalinity.

3.02 PREPARATION

A. Clean substrate surface free of foreign matter.

B. Patch wood substrate with latex filler to produce surface conducive to bond.

C. Patch concrete substrate with filler to produce surface conducive to bond.

D. Install cant strips securely at intersecting surfaces.

E. Protect adjacent surfaces.

3.03 INSTALLATION

A. Apply system materials in accordance with manufacturer's instructions.

B. Transitions to other floor finishes, where no other transition is indicated:
   1. Where traffic coating terminates at sealed concrete floor: feather coating to level of concrete.
   2. Where traffic coating terminates at finishes of greater thickness (i.e. Tile): Slope coating to level of finish by adding sand to mixture.
      a. Max slope 1/4" per foot.
      b. See manufacturer's instructions for proportion of sand to mix.

C. Finish to smooth surface sloped to drains.

D. Cove and omit aggregate at vertical surfaces.
   1. Where base is indicated, provide coved, 6" high base. See Finish Plans.

E. Apply surfacing to top coat before set.

F. Apply sealant to junction of horizontal and intersecting surfaces to achieve watertight seal.

3.04 PROTECTION

A. Do not permit traffic over unprotected surfaces.

END OF SECTION

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SECTION 07 21 00
THERMAL INSULATION

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Extruded Polystyrene Board insulation. (XPS) (INSUL-1)
      a. High strength Extruded Polystyrene Board. (INSUL-1A)
   2. Unfaced blanket/batt insulation. (INSUL-2)
   3. Sound attenuation Insulation. (INSUL-3)
   4. Faced/Unfaced Board insulation. (INSUL-4)
   5. Foil-Faced/ Fiber-Faced, Polyisocyanurate Board Insulation. (INSUL-5)
   6. Spray polyurethane foam insulation. (INSUL-6)
   7. High-Temp spray polyurethane foam insulation. (INSUL-7)
   8. Semi-Rigid mineral wool fiber batt insulation. (INSUL-8)
   9. Laminated Nailbase Insulation. (INSUL-9)
   10. Expanded Polystyrene Insulation (EPS or Geofoam). (INSUL-10)

B. See Section 06 16 13 - for Structural Insulating Sheathing.

C. See Section 07 24 19 - for EIFS insulation.

D. See Section 07 54 23 - for Roofing insulation.

E. See Section 22 07 00 - for Plumbing insulation.

F. See Section 23 07 00 - for HVAC insulation.

1.02 RELATED SECTIONS

A. Section 01 33 00 - Submittal Procedures.

B. Section 01 40 00 - Quality Requirements.

C. Section 01 60 00 - Product Requirements.

D. Section 03 30 00 - Cast in Place Concrete.

E. Section 03 45 70 - Architectural Site Cast Concrete Wall Panels.

F. Section 04 20 00 - Unit Masonry.

G. Section 07 13 25 - Self-Adhering (Post-Applied) Sheet Waterproofing

H. Section 07 14 50 - Fluid-Applied Waterproofing Membrane (alternate)

I. Section 07 24 19 - Water Drainage Exterior Insulation and Finish System.

J. Section 07 27 26 - Fluid-Applied Membrane Air Barrier

K. Section 07 42 00 - Metal Wall Panels.

L. Section 07 46 33 - Phenolic Wall Siding.

M. Section 07 54 24 - Thermoplastic Polyolefin (TPO) Roofing.

N. Section 07 81 00 - Applied Fireproofing.

O. Section 22 07 00 - Plumbing Insulation.

P. Section 23 07 00 - HVAC Insulation.

1.03 REFERENCE STANDARDS

A. ASTM C411 - Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation; Current Edition.

B. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.

C. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2023.

D. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).

E. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2023.

F. ASTM C1029 - Standard Specification for Spray-Applied Rigid Cellular Polyurethane Thermal Insulation; 2020.

G. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2023a.

H. ASTM D1621 - Standard Test Method for Compressive Properties of Rigid Cellular Plastics; 2016 (Reapproved 2023).

I. ASTM D1622 - Standard Test Method for Apparent Density of Rigid Cellular Plastics; 2020.

J. ASTM D6817/D6817M - Standard Specification for Rigid Cellular Polystyrene Geofoam; 2017 (Reapproved 2021).

K. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

L. D7180/D7180M - Standard Guide for Use of Expanded Polystyrene (EPS) Geofoam in Geotechnical Projects; 2013.

M. ICC (IECC) - International Energy Conservation Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

N. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00.

1.05 SUBMITTALS

A. Material and Equipment Submittals: Submit the following under provisions of Section 01 30 00:
   1. Manufacturer's installation instructions.
   2. Product Data: Submit product data for each type of insulation required.
      a. Clearly identify each location product is being used on each product data sheet.
      b. Provide all accessory materials, including their intended attachment method.
   3. Provide compatibility testing (pull test) for adhesives and their substrates.

B. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.
   3. See Sections 01 33 00 and 01 60 00.

1.06 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics:
   1. Comply with applicable codes for Class I (Class A) flame/smoke ratings of 25 or less/450 or less for insulation types and accessories other than foamed plastic; when tested according to ASTM E84 (UL 723).
   2. Comply with applicable codes for Class II (Class B) flame/smoke ratings of 75 or less/450 or less for foamed plastic insulation types; when tested according to ASTM E84 (UL 723).
   3. Provide minimum of 2 year workmanship warranty for all work included in Section 07 21 00.

PART 2 PRODUCTS

2.01 INSULATION MATERIALS

A. INSUL-1: Extruded Polystyrene Board Insulation: ASTM C578, Type VI, extruded cellular polystyrene; 1.6 pcf density minimum; 40 psi minimum compressive strength; 0.3 percent maximum water

absorption by volume; "k" factor of 0.20 at 75 deg. F; square edges, manufacturer's standard board sizes.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. DiversiFoam Products, Certifoam 25 SE.
   b. Dupont, Square Edge.
   c. Owens Corning, Foamular 250.
   d. Ox Engineered Products: Ox ISO Red Max Polyisocyanurate
2. R-Value 5/inch.
3. Thickness: Unless thickness is specifically noted on drawings, provide minimum R-value as defined by local energy code.

B. INSUL-1A **(NOT USED)**: High Load Extruded Polystyrene Board Insulation: ASTM C578, Type VII, extruded cellular polystyrene; 1.6 pcf density minimum; 60 psi minimum compressive strength; 0.1 percent maximum water absorption by volume; "k" factor of 0.20 at 75 deg. F; square edges, manufacturer's standard board sizes.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. DiversiFoam Products, Certifoam 60.
   b. Dupont, Styrofoam Highload 60.
   c. Owens Corning, Foamular 600..
   d. Or approved equal.
2. R-Value 5/inch.
3. Thickness: Unless thickness is specifically noted on drawings, provide minimum R-value as defined by local energy code.

C. INSUL-2 **(NOT USED)**: Glass Fiber Blanket/Batt Insulation (Unfaced): ASTM C665, Type I, preformed glass fiber blanket without facers.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. CertainTeed Corporation, Unfaced Building Insulation.
   b. Johns Manville, Cavity-Shield Unfaced Insulation Blankets.
   c. Owens-Corning Fiberglass Corp., Unfaced Glass Fiber Insulation.
   d. Or approved equal.
2. R-value: 3.2/inch.
3. Thickness: Provide minimum R-value of 13 where insulation is used in metal stud framed portions of the exterior wall.

D. INSUL-3: Sound Attenuation Insulation: ASTM C665, Type I, semi-rigid glass fiber blanket, thickness to fill cavity space.

1. Johns-Manville, JM unfaced Batts.
2. Owens-Corning Corp, EcoTouch Sonobatts.
3. Certainteed, Noise Reducer.
4. Or approved equal.

E. INSUL-4: Glass Fiber Board Insulation: ASTM C612, Form A, Class 1, semi-rigid glass fiber type; density of 2.25 pcf, faced one side with mesh reinforced aluminum foil; square edges. Surface burning characteristics of a Flame Spread rating of 25 or less and a Smoke Developed rating of 50 or less when the foil side is exposed. Thickness as indicated on Drawings.

1. Johns Manville Wall Insulation, FSK 25.
2. Knauf, Insulation Board, FSK Facing.
3. Owens-Corning, Flame Spread 25 nsulation.
4. Or approved equal.

F. INSUL-5: Foil-Faced/Fiber-Faced, Polyisocyanurate Board Insulation: ASTM C1289, Type I, Class 1, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E84.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    a. Atlas Roofing Corporation, EnergyShield.
    b. Johns-Manville, AP Foilfaced.
    c. Rmax, Inc, Thermasheath-3.
    d. Or approved equal.
2. R-value: 6.5/inch.
3. Thickness: Unless thickness is specifically noted on drawings, provide minimum R-value as follows:
    a. Where insulation is applied directly to the primary concrete structure of the exterior wall: 9.5
    b. Where insulation is applied to metal stud framed portions of the exterior wall: 13.

G. INSUL-6: Spray Polyurethane Foam Insulation: Closed-Cell Polyurethane Foam Insulation: ASTM C1029, Type II, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E84.
1. Manufacturers: Subject to compliance with requirements available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    a. BASF Corporation, WALLTITE – Basis of Design.
    b. Dow Chemical Company (The).
    c. Henry Company.
    d. NCFI; Division of Barnhardt Mfg. Co.
    e. SWD Urethane Company.
    f. Volatile Free, Inc.
2. Minimum density of 1.5 lb/cu. ft. (24 kg/cu. m), thermal resistivity of 6.2 deg F x h x sq. ft./Btu x in. at 75 deg F (43 K x m/W at 24 deg C).
3. Closed-Cell Spray-Foam product to achieve an aged R-value of 6.0 per inch.

H. INSUL-7: High Temperature Spray Polyurethane Foam Insulation: Rigid Closed-Cell Polyurethane Foam Insulation: ASTM C518, ASTM D1621 and ASTM D1622, Type II, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E84. Passes High Temperature Surface performance per ASTM C411..
1. Manufacturers: Subject to compliance with requirements available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    a. Basis of Design: Huntsman, "Heatlok High Temp".
    b. Dow Chemical Company.
    c. Henry Company.
    d. Or approved equal.
2. Compressive Strength: Minimum 38 psi.
3. Thermal Resistivity: Minimum 7 deg F x h x sq. ft./Btu x in. at 75 deg F (43 K x m/W at 24 deg C).
4. Density: Minimum 2.5 lb/cft.

I. INSUL-8: Mineral Wool Fiber Blanket/Batt Insulation: Non-Combustible, lightweight, foil faced semi-rigid mineral wool batt insulation; ASTM C612, Type IVB; Surface burning characteristics in accordance with ASTM E84, Class A; thermal requirements as indicated on drawings.
1. Basis of Design: Rockwool “CavityRock".
2. Acceptable Alternate Manufacturers: Subject to compliance with requirements specified, acceptable manufacturers are as follows:
    a. Johns Manville.
    b. Owens Corning/Thermafiber.
    c. Or approved equal.
3. Color: Black or Dark Gray.
4. R-value: 4.3/inch.

J. INSUL-9 **(NOT USED)**: Laminated Plywood Insulation: Closed-cell EPS, XPS or polyiso insulation board bonded to APA/TECO rated Oriented strand board (OSB) or plywood, ASTM C578. Thickness as shown on drawings.
   1. Acceptable Manufacturers and products.
      a. Atlas, EnergyShield Ply Pro.
      b. Insulfoam, InsulLam.
      c. Huber Engineered Wood, Zip Wall Sheathing.
      d. Or approved equal.

K. INSUL-10: Geofoam. Expanded Polystyrene (EPS).
   1. To comply with ASTM D6817/D6817M and D7180/D7180M, compressive resistance type indicated below and with flame spread index less than 25 and smoke developed index less than 450 per ASTM E84/ UL 723 .
   2. To be used as landscape/pool fill as shown on drawings.
   3. Compressive resistance:
      a. 60 psi min.

2.02 ACCESSORIES

A. Foil Tape: Flame retardant pressure-sensitive type recommended by insulation manufacturer for application, 2" wide minimum.

B. Adhesive: Type recommended by insulation manufacturer for application.

C. Impaling Pins: Impaling pins and locking washers as recommended by insulation manufacturer.

D. Smoke Seal Compound:
   1. Owen's Corning, Thermafiber Smoke Seal Compound.
   2. Or approved equal, see Section 07 84 00.

E. Thermal Barrier as noted in 07 81 00 for exposed spray polyurethane foam insulation.

PART 3 EXECUTION

3.01 PREPARATION

A. Verify substrate and adjacent materials and insulation boards are dry and ready to receive insulation.

3.02 INSTALLATION - FOUNDATIONS

A. Install XPS insulation (INSUL-1) at foundation walls where indicated on drawings.

B. See below for required R-value.

3.03 INSTALLATION - EXTERIOR WALLS

A. Install polyiscyanurate (INSUL-5) boards with adhesive applied according to manufacturer's instructions where rigid insulation is called for.
   1. Tape all board transitions.

B. Install mineral wool (INSUL-8) at the following locations and where indicated on drawings.
   1. Spandrel Glass.

C. Total Exterior Opaque Envelope R-value: 13 (ICC (IECC) Table C402.1.3)

D. See Section 07 24 19 for EIFS.

3.04 INSTALLATION - BLANKET/BATT INSULATION

A. Install thermal batt insulation (INSUL-2) as shown on drawings, in accordance with manufacturer's instructions.

B. Install batt insulation in walls without gaps or voids.

C. Trim insulation neatly to fit spaces. Use batts free of damage.

D. Fit insulation tight in spaces and tight to exterior side of mechanical and electrical services within the plane of insulation. Leave no gaps or voids.

E. Fill cracks and voids around framing and blocking, other voids in exterior walls, and voids around wood cants, curbs, and blocking in and about the roof. Wedge in place, completely filling voids.

3.05 INSTALLATION - SOUND ATTENUATION INSULATION

A. Install sound attenuation insulation (INSUL-3) in partitions and ceilings according to manufacturer's instructions as indicated on the Drawings.

B. Where a room having ACT is indicated to receive Sound Attenuation Insulation above the ceiling, extend insulation at same depth,12" into adjacent rooms with ACT as well.

C. Do not install Sound Attenuation Insulation over light fixtures.

3.06 INSTALLATION - FIBERGLASS BOARD INSULATION (FACED AND UNFACED)

A. Install Fiberglass Board (INSUL-4) as indicated on Drawings and in accordance with manufacturer's instructions.

B. Install around hot/humid interiors. See details.

3.07 INSTALLATION - SPRAY-APPLIED INSULATION

A. Install standard Spray Applied Insulation (INSUL-6) and High Temperature Spray Applied Insulation (INSUL-7) as indicated on Drawings.

B. Clean and prime all substrates per manufactures recommendations prior to installation of spray polyurethane foam insulation. Apply spray-applied insulation according to manufacturer's written instructions. Do not apply insulation until installation of pipes, ducts, conduits, wiring, and electrical outlets in walls is completed and windows, electrical boxes, and other items not indicated to receive insulation are masked. After insulation is applied, make flush with face of studs by using method recommended by insulation manufacturer.

C. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
   1. Spray Polyurethane Foam Insulation: Closed-Cell Polyurethane Foam Insulation.

D. Apply according to manufacturer's written instructions.
   1. High Temp Spray: Install within bench cavities and wherever else indicated on Drawings in manner to completely eliminate voids.

3.08 INSTALLATION - LAMINATED NAILBASE INSULATION

A. Install Laminated Nailbase Insulation (INSUL-9) as indicated on drawings and in accordance with manufacturer's instructions.

END OF SECTION

SECTION 07 24 19
WATER-DRAINAGE EXTERIOR INSULATION AND FINISH SYSTEM (EIFS)

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:
   1. EIFS-clad drainage-wall assemblies that are field applied over substrate.
   2. Exterior tile using EIFS as a tile backer board with drainage plane, Limited scope.
   3. Water-resistive coatings.
   4. Accessory materials.

1.03 RELATED REQUIREMENTS:

A. Section 01 31 00 - Project Management and Coordination
B. Section 01 33 00 - Submittal Procedures
C. Section 01 40 00 - Quality Requirements
D. Section 01 45 33 - Code-Required Special Inspections and Procedures
E. Section 01 60 00 - Product Requirements
F. Section 01 77 00 - Closeout Procedures
G. Section 01 92 00 - Facility Operation and Maintenance.
H. Section 03 45 70 - Architectural Site Cast Concrete Wall Panels
I. Section 04 20 00 - Unit Masonry Assemblies
J. Section 05 40 00 - Cold-Formed Metal Framing
K. Section 07 08 00 - Commissioning of Thermal and Moisture Protection
L. Section 07 21 00 - Thermal Insulation
M. Section 07 27 26 - Fluid-Applied Membrane Air Barrier
N. Section 07 62 00 - Sheet Metal Flashing and Trim
O. Section 07 92 00 - Joint Sealants
P. Section 09 30 00 - Tiling

1.04 DEFINITIONS

A. Definitions in ASTM E2110 apply to Work of this Section.
B. EIFS: Exterior insulation and finish system(s).
C. ICC (IBC): International Building Code.

1.05 REFERENCE STANDARDS

A. ASTM B117 Standard Practice for Operating Salt Spray (Fog) Apparatus
B. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.
C. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2023.
D. ASTM C1063 - Standard Specification for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-Based Plaster; 2023.
E. ASTM C1397 - Standard Practice for Application of Class PB Exterior Insulation and Finish Systems (EIFS) and EIFS with Drainage; 2013 (Reapproved 2019).

F. ASTM C1397 - Standard Practice for Application of Class PB Exterior Insulation and Finish Systems (EIFS) and EIFS with Drainage; Current Edition.

G. ASTM D968 - Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive; 2022.

H. ASTM D1784 - Standard Classification System and Basis for Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds; 2020.

I. ASTM D3274 - Standard Test Method for Evaluating Degree of Surface Disfigurement of Paint Films by Fungal or Algal Growth, or Soil and Dirt Accumulation; Current Edition, Including All Revisions.

J. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

K. ASTM E2098 - Standard Test Method for Determining Tensile Breaking Strength of Glass Fiber Reinforcing Mesh for Use in Class PB Exterior Insulation and Finish Systems (EIFS), after Exposure to a Sodium Hydroxide Solution; Current Edition.

L. ASTM E2110 - Standard Terminology for Exterior Insulation and Finish Systems (EIFS); Current Edition.

M. ASTM E2359 - Standard Test Method for Field Pull Testing of an In-Place Exterior Insulation and Finish System Clad Wall Assembly; Current Edition.

N. ASTM E2511 - Standard Guide for Detailing of EIFS-Clad Barrier and Drainage Wall Assemblies; Current Edition.

O. ASTM E2568 - Standard Specification for PB Exterior Insulation and Finish Systems; Current Edition.

P. ASTM E2570/E2570M - Standard Test Methods for Evaluating Water-Resistive Barrier (WRB) Coatings Used Under Exterior Insulation and Finish Systems (EIFS) or EIFS with Drainage; 2007 (Reapproved 2019).

Q. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

R. ICC-ES AC219 - Acceptance Criteria for Exterior Insulation and Finish Systems; 2009, with Editorial Revision (2022).

S. ISO 9001 - Quality Management Systems — Requirements; 2015, with Amendment (2024).

T. ISO 14001 - Environmental Management Systems — Requirements with Guidance for Use; 2015.

U. NFPA 268 Standard Test Method for Determining Ignitability of Exterior Wall Assemblies Using a Radiant Heat Source.

V. NFPA 285 Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load Bearing Wall Assemblies Containing Combustible Components.

W. AATCC 127-08 Water Resistance: Hydrostatic Pressure Test.

X. TT-S-001543A Sealing Compound: Silicone Rubber Base (for Calking, Sealing, and Glazing in Buildings and Other Structures)

Y. TT-S-00230 Sealing Compound: Elastomeric Type, Single Component (for Calking, Sealing, and Glazing in Buildings and Other Structures.

1.06 PERFORMANCE REQUIREMENTS

A. EIFS Performance: Comply with ASTM E2568 and with the following:
   1. Weathertightness: Resistant to uncontrolled water penetration from exterior, with a means to drain water entering EIFS to the exterior.
   2. Structural Performance: EIFS assembly and components shall comply with ICC-ES AC219 when tested according to ASTM E2568.
      a. Wind Loads: Design wind pressures shall be based on Basic Wind Speed, Risk Category, Exposure Category, and Internal Pressure Coefficient indicated on Structural Drawings.
   3. Impact Performance: ASTM E2568, Standard impact resistance unless otherwise indicated.

4. Abrasion Resistance of Finish Coat: Sample consisting of 1-inch- (25.4-mm-) thick EIFS mounted on 1/2-inch- (12.7-mm-) thick gypsum board; cured for a minimum of 28 days and shows no cracking, checking, or loss of film integrity after exposure to 528 quarts (500 L) of sand when tested according to ASTM D968, Method A.
5. Mildew Resistance of Finish Coat: Sample applied to 2-by-2-inch (50.8-by-50.8-mm) clean glass substrate; cured for 28 days and shows no growth when tested according to ASTM D3274.

B. Air and Water-resistive Barrier
1. Assembly air leakage less than 0.04 cfm/ft2 (0.2 L/s·m2) after conditioning protocol when measured in accordance with ASTM E2357
2. Vapor Permeable, Water vapor permeance greater than 10 perms when measured in accordance with ASTM E96, Method B
3. Vapor Impermeable, Water vapor permeance less than 0.1 perms when measured in accordance with ASTM E96, Method B
4. No water penetration when subjected to sequential water spray of 2.86 psf (137 Pa), then 6.24 psf (299 Pa), for 15 minutes at each pressure interval, when measured in accordance with ASTM E331
5. Meets or exceeds maximum allowable material air leakage requirements of the 2021 and 2018 IECC based on independent laboratory testing in accordance with ASTM E2178
6. Meets VOC standard of South Coast AQMD Rule 1113 for Building Envelope Coatings

1.07 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
1. Include representatives of the Manufacturer, the Applicator, substrate installers, the Owner and Construction Manager.

1.08 SUBMITTALS

A. Action Submittals:
1. Product Data: For each EIFS component, trim, and accessory, including water-resistive coatings.
2. Samples: (2 ea) For each exposed product and for each color and texture specified, 8 inches (200 mm) square in size.
3. Samples for verification: 24-inch - (600-mm-) square panels for each type of finish-coat color and texture indicated, prepared using same tools and techniques intended for actual work including custom trim, each profile.
4. Shop Drawings: Show colors, profiles and details of each condition.

B. Informational Submittals:
1. Qualification Data: For Installer.
2. Manufacturer Certificates: Signed by EIFS manufacturer certifying the following:
   a. EIFS complies with requirements.
   b. Substrates to which EIFS is indicated to be attached are acceptable to EIFS manufacturer.
   c. Accessory products installed with EIFS, including joint sealants, flashing, water-resistive coatings, trim, whether or not furnished by EIFS manufacturer and whether or not specified in this Section, are acceptable to EIFS manufacturer.
3. Product Certificates: For cementitious materials and aggregates and for insulation and joint sealant, from manufacturer.
4. Product Test Reports: For each EIFS assembly and component, and for water-resistive coatings, for tests performed by a qualified testing agency.
5. Perform and submit reports of Code Required Special Inspections as required in Section 01 45 33.
6. Field quality-control reports and special inspection reports.
7. Sample Warranty: For manufacturer's special warranty.

C. Mock-up:
1. See 1.09 Quality Assurance and drawings for requirements of Mock Up.

D. Procurement:

1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
2. Submit inventory to Owner within 5 days of delivery of materials.
3. See Sections 01 33 00 and 01 60 00.

E. Closeout Submittals:
1. Operation and Maintenance Data: Submit O&M manuals according to the requirements of Section 01 92 00 - Facility Operation and Maintenance.
2. Submit an executed copy of the Exterior Insulation and Finish System with Moisture Drainage manufacturer's comprehensive single source limited warranty.

1.09 QUALITY ASSURANCE

A. Manufacturer qualifications:
1. Facility Certified by ANSI-RAB according to current ISO 9001 and ISO 14001.

B. Installer Qualifications: An installer who is certified in writing by EIFS manufacturer as qualified to install manufacturer's system using trained workers.

C. Accessory materials manufacturer: Certified by EIFS manufacturer as producing materials compatible with EIFS.

D. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, to set quality standards for materials and execution, to test for compliance with specified requirements and to set quality standards for fabrication and installation.
1. Mockups will be tested for compliance to the requirements of 1.06 Performance Requirements and according to the Commissioning Plan. See Section 01 92 00.

1.10 REGULATORY REQUIREMENTS

A. Separate the EPS insulation board from the interior of the building by a minimum 15-minute thermal barrier.

B. Comply with local building codes for the use and maximum thickness of EPS insulation board.

C. Cooperate with independent, third-party inspectors when required by code or contract documents.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original, unopened packages with manufacturers' labels intact and clearly identifying products.

B. Inspect all Exterior Insulation and Finish System with Moisture Drainage components and materials upon arrival for physical damage, freezing or overheating. Do not use questionable materials.

C. Store materials inside and under cover; keep them dry and protected from weather, direct sunlight, surface contamination, aging, corrosion, damaging temperatures, construction traffic, and other causes.
1. Stack insulation board flat and off the ground.
2. Protect plastic insulation against ignition at all times. Do not deliver plastic insulating materials to Project site before installation time.
3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.
4. Minimize exposure of materials to temperatures over 90 °F (32 °C). Finishes exposed to temperatures over the published maximum storage temperature for even short periods may exhibit skinning and increased viscosity and shall be inspected prior to use.

1.12 FIELD CONDITIONS

A. Weather Limitations:
1. Maintain ambient temperatures above 40 deg F (4.4 deg C) for a minimum of 24 hours before, during, and after adhesives or coatings are applied.
2. Maintain ambient and surface temperatures between 45 and 85 degrees F (7 and 29 degrees C) during application and drying period of AMV adhesive – not less than 24 hours
3. Do not apply EIFS adhesives or coatings during rainfall.

4. Proceed with installation only when existing and forecasted weather conditions and ambient outdoor air, humidity, and substrate temperatures permit EIFS to be applied, dried, and cured according to manufacturers' written instructions and warranty requirements.

1.13 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace components of EIFS-clad drainage-wall assemblies that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Bond integrity and weathertightness.
      b. Deterioration of EIFS finishes and other EIFS materials beyond normal weathering.
   2. Warranty coverage includes the following components of EIFS-clad drainage-wall assemblies:
      a. EIFS finish, including base coats, finish coats, and reinforcing mesh.
      b. Insulation installed as part of EIFS including foam build-outs.
      c. Insulation adhesive and mechanical fasteners.
      d. EIFS accessories, including trim components, joint sealant backing and flashing.
      e. Water-resistive coatings.
      f. EIFS drainage components.
   3. Warranty Period: 12 (min) years from date of Substantial Completion.
      a. Obtain longer warranty period where qualified.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design: Subject to compliance with requirements, provide products by the following:
   1. Dryvit Systems, Inc.
      a. Dryvit Outsulation and Dryvit Outsulation Masonry Veneer System (OMVS).
         1) Manufacturer’s recommended EPS Insulation Board.

B. Alternative manufacturers: Subject to compliance with requirements, provide products by the following:
   1. Sto Corp; www.stocorp.com
   2. Or approved substitution.

C. Source Limitations: Obtain EIFS from single source from single EIFS manufacturer and from sources approved by EIFS manufacturer as compatible with EIFS components.

2.02 SYSTEM DESCRIPTION

A. System to include the following components. All components are subject to the source limitations specified above.
   1. Air and Water Resistive Membrane Barrier. Vapor Permeable and Impermeable.
   2. Accessory Materials.
   3. Adhesive - installed in vertical ribbons to facilitate egress of incidental moisture.
   4. Expanded Polystyrene (EPS) Insulation Board.
   5. Base Coat.
   6. Reinforcing Mesh.
   7. Finish Coat.
   8. Joint Sealants.

2.03 EIFS MATERIALS

A. Primer/Sealer: EIFS manufacturer's standard substrate conditioner designed to protect substrates from moisture penetration and to improve the bond between substrate and insulation adhesive; with VOC content of 250 g/L or less.

B. Water-Resistive Coatings: Manufacturer's compatible barrier and accessories for use as water-resistive barriers; compatible with substrate and complying with physical and performance criteria of ASTM E2570/E2570M.
   1. Vapor Impermeable – Dryvit,Backstop NT-VB.

2. Vapor Permeable – Backstop NTX.

C. Flexible-Membrane Flashing: Cold-applied, self-adhering, self-healing, rubberized-asphalt and polyethylene-film composite sheet or tape and primer; EIFS manufacturer's standard or product recommended in writing by EIFS manufacturer.

D. Insulation Adhesive: EIFS manufacturer's standard formulation designed for indicated use; specifically formulated to be applied to back side of insulation in a manner that creates open vertical channels designed to serve as an integral part of the water-drainage system of the EIFS-clad drainage-wall assembly; compatible with substrate; and complying with one of the following:
   1. Factory-blended dry formulation of portland cement, dry polymer admixture, and fillers specified for base coat.
   2. Factory-mixed non-cementitious formulation designed for adhesive attachment of insulation to substrates of type indicated, as recommended by EIFS manufacturer.

E. Molded, Rigid Cellular Polystyrene Board Insulation: Comply with ASTM C578, Type I; and EIFS manufacturer's requirements for most stringent requirements for material performance and qualities of insulation, including dimensions and permissible variations, and the following:
   1. Aging: Before cutting and shipping, age insulation in block form by air drying for not less than six weeks.
   2. Flame-Spread and Smoke-Developed Indexes: 25 and 450 or less, respectively, according to ASTM E84.
   3. Dimensions: Provide insulation boards of not more than 24 by 48 inches (610 by 1219 mm) thick or in other thickness indicated, but not more than 4 inches (102 mm) thick or less than the thickness allowed by ASTM C1397.
   4. Channeled Board Insulation: EIFS manufacturer's standard factory-fabricated profile with linear, vertical-drainage channels, slots, or waves on the back side of board.
   5. Foam Build-Outs: Provide with profiles and dimensions indicated on Drawings.
   6. Reveals: As indicated on drawings. Profile to be "V" shaped, and 3/4" wide.

F. Reinforcing Mesh: Balanced, alkali-resistant, open-weave, glass-fiber mesh treated for compatibility with other EIFS materials, made from continuous multiend strands with retained mesh tensile strength of not less than 120 lbf/in. (21 dN/cm) according to ASTM E2098 and the following:
   1. Reinforcing Mesh for EIFS, General: Not less than weight required to meet impact-performance level specified in "Performance Requirements" Article.
   2. Strip Reinforcing Mesh: Not less than as recommended by EIFS manufacturer.
   3. Detail Reinforcing Mesh: Not less than as recommended by EIFS manufacturer.
   4. Corner Reinforcing Mesh: Not less than as recommended by EIFS manufacturer.

G. Base-Coat Materials: EIFS manufacturer's standard mixture complying with one of the following:
   1. Factory-blended dry formulation of portland cement, dry polymer admixture, and inert fillers to which only water is added at Project site.
   2. Factory-mixed noncementitious formulation of polymer-emulsion adhesive and inert fillers that is ready to use without adding other materials.

H. Waterproof Adhesive/Base-Coat Materials: EIFS manufacturer's standard waterproof formulation with VOC content of 50 g/L or less complying with one of the following:
   1. Job-mixed formulation of portland cement complying with ASTM C150/C150M, Type I, white or natural color; and manufacturer's standard polymer-emulsion adhesive designed for use with portland cement.
   2. Job-combined formulation of manufacturer's standard polymer-emulsion adhesive and manufacturer's standard dry mix containing portland cement.

I. Primer: EIFS manufacturer's standard factory-mixed, elastomeric-polymer primer for preparing base-coat surface for application of finish coat.

J. Finish-Coat Materials: EIFS manufacturer's complying with the following:

1. Factory-mixed formulation of polymer-emulsion binder, colorfast mineral pigments, and fillers used with stone particles for embedding in finish coat to produce an applied-aggregate finish.
    a. Aggregate: Marble chips of size and color to match Architect's sample.
2. Colors: As specified herein and matching Architect's sample.
3. Textures: As specified herein and matching Architect's sample.

K. Water: Potable.

L. Trim Accessories: Type as designated or required to suit conditions indicated and to comply with EIFS manufacturer's written instructions; manufactured from UV-stabilized PVC; and complying with ASTM D1784, manufacturer's standard cell class for use intended, and ASTM C1063.
1. Casing Bead: Prefabricated, one-piece type for attachment behind insulation, of depth required to suit thickness of coating and insulation, with face leg perforated for bonding to coating and back leg.
2. Drip Screed/Track: Prefabricated, one-piece type for attachment behind insulation with face leg extended to form a drip, of depth required to suit thickness of coating and insulation, with face leg perforated for bonding to coating and back leg.
3. Weep Screed/Track: Prefabricated, one-piece type for attachment behind insulation with perforated face leg extended to form a drip and weep holes in track bottom, of depth required to suit thickness of coating and insulation, with face leg perforated for bonding to coating and back leg; designed to drain incidental moisture that gets into wall construction to the exterior at terminations of EIFS with drainage.
4. Expansion Joint: Prefabricated, one-piece V profile; designed to relieve stress of movement.
5. Windowsill Flashing: Prefabricated type for both flashing and sloping sill over framing beneath windows; with end and back dams; designed to direct water to exterior.
6. Parapet Cap Flashing: Type for both flashing and covering parapet top with design complying with ASTM C1397.
7. Joint Sealant Backing
    a. Outer weather seal: cylindrical non-absorbent bi-cellular polyethylene foam backer rod with outer skin in conformance with ASTM C1330, Type B

M. Sealants: Provide Sealants as recommended by manufacturer. See Section 07 92 00.
1. Tremco Spectrem 1: An ultra low modulus, high-performance, one-part, moisture-curing silicone joint sealant with physical properties making it an ideal sealant for sealing dynamic joints.
    a. Tremco Spectrem 1.
    b. Dowsil 756 SMS.

2.04 MIXING

A. Comply with EIFS manufacturer's requirements for combining and mixing materials. Do not introduce admixtures, water, or other materials except as recommended by EIFS manufacturer. Mix materials in clean containers. Use materials within time period specified by EIFS manufacturer or discard.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
1. Refer to manufacturer's instructions for installation tolerances.

B. Examine roof edges, wall framing, flashings, openings, substrates, and junctures at other construction for suitable conditions where EIFS will be installed.
1. Refer to SMACNA standards, EIFS manufacturer's details for requirements for flashing installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.
1. Begin coating application only after surfaces are dry.
2. Application of coating indicates acceptance of surfaces and conditions.

3.02 PREPARATION

A. Protect contiguous work from moisture deterioration and soiling caused by application of EIFS. Provide temporary covering and other protection needed to prevent spattering of exterior finish coats on other work.

B. Protect EIFS, substrates, and wall construction behind them from inclement weather during installation. Prevent penetration of moisture behind drainage plane of EIFS and deterioration of substrates.

C. Prepare and clean substrates to comply with EIFS manufacturer's written instructions to obtain optimum bond between substrate and adhesive for insulation.
   1. Concrete Substrates: Provide clean, dry, neutral-pH substrate for insulation installation. Verify suitability of substrate by performing bond and moisture tests recommended by EIFS manufacturer.

3.03 EIFS INSTALLATION, GENERAL

A. Comply with ASTM C1397, ASTM E2511, and EIFS manufacturer's written instructions for installation of EIFS as applicable to each type of substrate indicated.

B. Install high impact reinforcing mesh as specified at ground level, high traffic areas, play areas, sport areas and other areas exposed to impact damage as designated on contract documents.
   1. Install to 6' height at typical ground level areas.
   2. Install to 12' height where play or outdoor sport areas are adjacent.

3.04 SUBSTRATE PROTECTION APPLICATION

A. Primer/Sealer: Apply over substrates and where required by EIFS manufacturer for improving adhesion of insulation to substrate.

B. Water-Resistive Coating: Apply over EIFS to provide a water-resistive barrier.
   1. Tape and seal joints, exposed edges, terminations, and inside and outside corners of sheathing unless otherwise indicated by EIFS manufacturer's written instructions.

C. Flexible-Membrane Flashing: Install over weather-resistive barrier, applied and lapped to shed water; seal at openings, penetrations, terminations, and where required by EIFS manufacturer. Prime substrates if required and install flashing to comply with EIFS manufacturer's written instructions and details.

3.05 TRIM INSTALLATION

A. Trim: Apply trim accessories at perimeter of EIFS, at expansion joints, at windowsills, and elsewhere as indicated. Coordinate with installation of insulation.
   1. Weep Screed/Track: Use at bottom termination edges, at window and door heads, and at floor line expansion joints of water-drainage EIFS unless otherwise indicated.
   2. Windowsill Flashing: Use at windows unless otherwise indicated.
   3. Expansion Joint: Use where indicated on Drawings.
   4. Casing Bead: Use at other locations.
   5. Parapet Cap Flashing: Use where indicated on Drawings.

3.06 INSULATION INSTALLATION

A. Board Insulation: Attach insulation to substrate in compliance with ASTM C1397 and the following:
   1. Apply adhesive to insulation by notched-trowel method in a manner that results in coating the entire surface of drainage mat with adhesive once insulation is adhered to drainage mat.
   2. Apply Insulation in vertical orientation to allow for drainage.
   3. Press and slide insulation into place. Apply pressure over the entire surface of insulation to accomplish uniform contact, high initial grab, and overall level surface.
   4. Allow adhered insulation to remain undisturbed for not less than 24 hours, before beginning rasping and sanding insulation or applying base coat and reinforcing mesh.
   5. Apply insulation over substrates in courses with long edges of boards oriented horizontally.

6. Begin first course of insulation from screed/track and work upward. Work from perimeter casing beads toward interior of panels if possible.
7. Stagger vertical joints of insulation boards in successive courses to produce running bond pattern. Locate joints so no piece of insulation is less than 12 inches (300 mm) wide or 6 inches (150 mm) high. Offset joints not less than 6 inches (150 mm) from corners of window and door openings and not less than 4 inches (100 mm) from aesthetic reveals.
    a. Adhesive Attachment: Offset joints of insulation not less than 6 inches (150 mm) from horizontal and 4 inches (100 mm) from vertical joints in sheathing.
    b. Mechanical Attachment: Offset joints of insulation from horizontal joints in sheathing.
8. Interlock ends at internal and external corners.
9. Abut insulation tightly at joints within and between each course to produce flush, continuously even surfaces without gaps or raised edges between boards. If gaps greater than 1/16 inch (1.6 mm) occur, fill with insulation cut to fit gaps exactly; insert insulation without using adhesive or other material.
10. Cut insulation to fit openings, corners, and projections precisely and to produce edges and shapes complying with details indicated.
11. Rasp or sand flush entire surface of insulation to remove irregularities projecting more than 1/32 inch (0.8 mm) from surface of insulation and to remove yellowed areas due to sun exposure; do not create depressions deeper than 1/16 inch (1.6 mm). Prevent airborne dispersal and immediately collect insulation raspings or sandings.
12. Cut aesthetic reveals in outside face of insulation with high-speed router and bit configured to produce grooves, rabbets, and other features that comply with profiles and locations indicated. Do not reduce insulation thickness at aesthetic reveals to less than 3/4 inch (19 mm).
13. Install foam build-outs and attach to structure.
14. Interrupt insulation for expansion joints where indicated.
15. Form joints for sealant application by leaving gaps between adjoining insulation edges and between insulation edges and dissimilar adjoining surfaces. Make gaps wide enough to produce joint widths indicated after encapsulating joint substrates with base coat and reinforcing mesh.
16. Form joints for sealant application with back-to-back casing beads for joints within EIFS and with perimeter casing beads at dissimilar adjoining surfaces. Make gaps between casing beads and between perimeter casing beads and adjoining surfaces of width indicated.
17. After installing insulation and before applying field-applied reinforcing mesh, fully wrap board edges. Cover edges of board and extend encapsulating mesh not less than 2-1/2 inches (64 mm) over front and back face unless otherwise indicated on Drawings.
18. Treat exposed edges of insulation as follows:
    a. Except for edges forming substrates of sealant joints, encapsulate with base coat, reinforcing mesh, and finish coat.
    b. Encapsulate edges forming substrates of sealant joints within EIFS or between EIFS and other work with base coat and reinforcing mesh.
    c. At edges trimmed by accessories, extend base coat, reinforcing mesh, and finish coat over face leg of accessories.
19. Coordinate installation of flashing and insulation to produce wall assembly that does not allow water to penetrate behind flashing and water-resistive barrier.

B. Expansion Joints: Install at locations indicated, where required by EIFS manufacturer, and as follows:
1. At expansion joints in substrates behind EIFS.
2. Where EIFS adjoin dissimilar substrates, materials, and construction, including other EIFS.
3. At floor lines in multilevel wood-framed construction.
4. Where wall height or building shape changes.
5. Where EIFS manufacturer requires joints in long continuous elevations.

3.07 BASE-COAT INSTALLATION

A. Waterproof Adhesive/Base Coat: To exposed surfaces of insulation, apply in minimum thickness recommended in writing by EIFS manufacturer where indicated on Drawings.

B. Base Coat: Apply to exposed surfaces of insulation and foam build-outs in minimum thickness recommended in writing by EIFS manufacturer, but not less than 1/16-inch (1.6-mm) dry-coat thickness.

C. Reinforcing Mesh: Embed reinforcing mesh in wet base coat to produce wrinkle-free installation with mesh continuous at corners, overlapped not less than 2-1/2 inches (64 mm) or otherwise treated at joints to comply with ASTM C1397 and EIFS manufacturer's written instructions. Do not lap reinforcing mesh within 8 inches (204 mm) of corners. Completely embed mesh, applying additional base-coat material if necessary, so reinforcing-mesh color and pattern are invisible.

D. Double-Layer Reinforcing-Mesh Application: Where indicated or required, apply second base coat and second layer of reinforcing mesh, overlapped not less than 2-1/2 inches (64 mm) or otherwise treated at joints to comply with ASTM C1397 and EIFS manufacturer's written instructions in same manner as first application. Do not apply until first base coat has cured.

E. Additional Reinforcing Mesh: Apply strip reinforcing mesh around openings, extending 4 inches (100 mm) beyond perimeter. Apply additional 9-by-12-inch (230-by-300-mm) strip reinforcing mesh diagonally at corners of openings (re-entrant corners). Apply 8-inch- (200-mm-) wide, strip reinforcing mesh at both inside and outside corners unless base layer of mesh is lapped not less than 4 inches (100 mm) on each side of corners.
   1. Install high impact mesh at any first floor locations and wherever EIFS is adjacent to occupied areas.
   2. At aesthetic reveals, apply strip reinforcing mesh not less than 8 inches (200 mm) wide.
   3. Embed strip reinforcing mesh in base coat before applying first layer of reinforcing mesh.

F. Foam Build-Outs: Fully embed reinforcing mesh in base coat.

G. Double Base-Coat Application: Where indicated, apply second base coat in same manner and thickness as first application, except without reinforcing mesh. Do not apply until first base coat has cured.

3.08 FINISH-COAT INSTALLATION

A. Primer: Apply over dry base coat according to EIFS manufacturer's written instructions.

B. Finish Coat: Apply over dry primed base coat, maintaining a wet edge at all times for uniform appearance, in thickness required by EIFS manufacturer to produce a uniform finish of color and texture matching approved sample and free of cold joints, shadow lines, and texture variations.

C. Sealer Coat: Apply over dry finish coat, in number of coats and thickness required by EIFS manufacturer.

3.09 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
   1. As stipulated in Ch. 17 of the ICC (IBC).

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

C. EIFS Tests and Inspections: According to ASTM E2359.

D. EIFS will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.10 CLEANING AND PROTECTION

A. Remove temporary covering and protection of other work. Promptly remove coating materials from window and door frames and other surfaces outside areas indicated to receive EIFS coatings.

3.11 EIFS SCHEDULE

A. Color and Texture:
   1. EIFS-4: Match Stratotone "Buckskin #449ST"
      a. Texture: Senergy “Sahara,” or Dryvit “Sand Pebble” Texture, UNO.
   2. EIFS-5:

a. Color: Match color of aluminum storefront Dark Bronze, UNO.
b. Texture: Sandpebble Fine

3. EIFS-6:
   a. Color: Dryvit #522ST Lite Gray, UNO
   b. Texture: Sandpebble Fine.
4. EIFS – 7
   a. Color/ Texture: N/A, behind tile.

END OF SECTION

SECTION 07 24 20
POLYMER-BASED INTERIOR FINISH SYSTEM (IFS)

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Polymer-based Interior finish system (IFS) applied over concrete, masonry, and gypsum sheathing where indicated on Drawings.

1.02 RELATED SECTIONS

A. Section 01 31 00 - Project Management and Coordination
B. Section 01 33 00 - Submittal Procedures
C. Section 01 40 00 - Quality Requirements
D. Section 01 45 33 - Code-Required Special Inspections and Procedures
E. Section 01 60 00 - Product Requirements
F. Section 01 77 00 - Closeout Procedures
G. Section 01 92 00 - Facility Operation and Maintenance
H. Section 04 20 00 - Unit Masonry
I. Section 06 10 00 - Rough Carpentry
J. Section 07 62 00 - Sheet Metal Flashing and Trim
K. Section 07 92 00 - Joint Sealants
L. Section 09 21 16 - Gypsum Board Assemblies

1.03 SYSTEM DESCRIPTION

A. Class PB IFS: An interior wall finish system that consists of an integrally reinforced base coat; and a textured protective finish coat.

1.04 REFERENCE STANDARDS

A. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.
B. ASTM C1063 - Standard Specification for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-Based Plaster; 2023.
C. ASTM C1397 - Standard Practice for Application of Class PB Exterior Insulation and Finish Systems (EIFS) and EIFS with Drainage; 2013 (Reapproved 2019).
D. ASTM D578/D578M - Standard Specification for Glass Fiber Strands; 2018.
E. ASTM D968 - Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive; 2022.
F. ASTM D1784 - Standard Classification System and Basis for Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds; 2020.
G. ASTM D2247 - Standard Practice for Testing Water Resistance of Coatings in 100 % Relative Humidity; 2015 (Reapproved 2020).
H. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.
I. ASTM D3274 - Standard Test Method for Evaluating Degree of Surface Disfigurement of Paint Films by Fungal or Algal Growth, or Soil and Dirt Accumulation; Current Edition, Including All Revisions.
J. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).

K. ASTM E2098 - Standard Test Method for Determining Tensile Breaking Strength of Glass Fiber Reinforcing Mesh for Use in Class PB Exterior Insulation and Finish Systems (EIFS), after Exposure to a Sodium Hydroxide Solution; Current Edition.

L. ASTM G153 - Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials; 2013 (Reapproved 2021).

M. ASTM G155 - Standard Practice for Operating Xenon Arc Lamp Apparatus for Exposure of Materials; 2021.

N. ICC-ES AC219 - Acceptance Criteria for Exterior Insulation and Finish Systems; 2009, with Editorial Revision (2022).

1.05 PERFORMANCE REQUIREMENTS

A. IFS Performance: Comply with the following:
   1. Bond Integrity: Free from bond failure within IFS components or between system and supporting wall construction, resulting from exposure to fire, wind loads, weather, or other in-service conditions.
   2. Weathertightness: Resistant to water penetration from exterior into IFS and assemblies behind it or through them into interior of building that results in deterioration of thermal-insulating effectiveness or other degradation of IFS and assemblies behind it, including substrates, supporting wall construction, and interior finish.

B. Class PB IFS: Provide IFS having physical properties and structural performance that comply with the following:
   1. Abrasion Resistance: Sample consisting of 1-inch- (25.4-mm-) IFS mounted on 1/2-inch- (12.7-mm-) thick gypsum board; cured for a minimum of 28 days; and showing no cracking, checking, or loss of film integrity after exposure to 528 quarts (500 L) of sand when tested per ASTM D968, Method A.
   2. Absorption-Freeze Resistance: No visible deleterious effects and negligible weight loss after 60 cycles per EIMA 101.01.
   3. Accelerated Weathering: Five samples per ICC-ES AC219 showing no cracking, checking, crazing, erosion, rusting, blistering, peeling, delamination, or other characteristics that might affect performance as a wall cladding after testing for 2000 hours when viewed under 5 times magnification per ASTM G153 or ASTM G155.
   4. Freeze-Thaw: No surface changes, cracking, checking, crazing, erosion, rusting, blistering, peeling, or delamination, or indications of delamination between components when viewed under 5 times magnification after 10 cycles per ICC-ES AC219.
   5. Mildew Resistance of Finish Coat: Sample applied to 2-by-2-inch (50.8-by-50.8-mm) clean glass substrate, cured for 28 days, and showing no growth when tested per ASTM D3273 and evaluated according to ASTM D3274.
   6. Salt-Spray Resistance: No deleterious affects when tested according to ICC-ES AC219.
   7. Tensile Adhesion: No failure in the IFS, adhesive, base coat, or finish coat when tested per ICC-ES AC219.
   8. Water Penetration: Sample consisting of IFS Base Coat and Finish Coat mounted on 1/2-inch-(12.7-mm-)thick gypsum board, cured for 28 days, and showing no water penetration into the plane of the base coat to expanded-polystyrene board interface of the test specimen after 15 minutes at 6.24 lbf/sq. ft. (299 Pa) of air pressure difference or 20 percent of positive design wind pressure, whichever is greater, across the specimen during a test period when tested per EIMA 101.02.
   9. Water Resistance: Three samples, each consisting of IFS Base Coat and Finish Coat mounted on 1/2-inch- (12.7-mm-) thick gypsum board; cured for 28 days; and showing no cracking, checking, crazing, erosion, rusting, blistering, peeling, or delamination after testing for 14 days per ASTM D2247.
   10. Wind-Driven-Rain Resistance: Resist wind-driven rain according to ICC-ES AC219.

11. Impact Resistance: Sample consisting of IFS Base Coat and Finish Coat when constructed, conditioned, and tested per EIMA 101.86; and meeting or exceeding the Standard Impact Resistance: 25 to 49 inch-lb (2.8 to 5.6 J).
12. Structural Performance Testing: IFS assembly and components shall comply with ICC-ES AC219 when tested per ASTM E330/E330M.

1.06 SUBMITTALS

A. Product Data: For each type and component of IFS indicated.

B. Samples for Verification: 24-inch- (600-mm-) square panels for each type of finish-coat color and texture indicated, prepared using same tools and techniques intended for actual work including a typical control joint filled with sealant of color selected.
   1. Include sealants Samples to verify color selected.

C. Qualification Data: For Installer, fabricator/erector, and testing agency.

D. Product Test Reports:
   1. Based on evaluation of comprehensive tests performed by a qualified testing agency, for each insulation, reinforcing mesh, and coating.

E. Compatibility and Adhesion Test Reports: For joint sealants from sealant manufacturer indicating the following:
   1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
   2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

F. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.
   3. See Sections 01 33 00 and 01 60 00.

G. Operation and Maintenance Data: Submit O&M manuals according to the requirements of Section 01 92 00 - Facility Operation and Maintenance.

1.07 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Installer Qualifications: An installer who is certified in writing by manufacturer as qualified to install manufacturer's system using trained workers.

C. Source Limitations: Obtain IFS from single source from single manufacturer and from sources approved by IFS manufacturer as compatible with system components.

D. Fire-Test-Response Characteristics: Provide IFS and system components with the following fire-test-response characteristics as determined by testing identical IFS and system components per UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing agency.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original, unopened packages with manufacturers' labels intact and clearly identifying products.

B. Store materials inside and under cover; keep them dry and protected from weather, direct sunlight, surface contamination, aging, corrosion, damaging temperatures, construction traffic, and other causes.

1.09 PROJECT CONDITIONS

A. Weather Limitations: Maintain ambient temperatures above 40 deg F (4.4 deg C) for a minimum of 24 hours before, during, and after adhesives or coatings are applied. Do not apply IFS adhesives or coatings during rainfall. Proceed with installation only when existing and forecasted weather

conditions and ambient outdoor air, humidity, and substrate temperatures permit IFS to be applied, dried, and cured according to manufacturers' written instructions and warranty requirements.

1.10 COORDINATION

A. Coordinate installation of IFS with related Work specified in other Sections to ensure that wall assemblies, including sheathing, flashing, trim, joint sealants, windows, and doors, are protected against damage from the effects of weather, age, corrosion, moisture, and other causes. Do not allow water to penetrate behind flashing and barrier coating of IFS.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Senergy; Basecoat, Mesh and Finish Coat., or comparable product by one of the following:
   1. Dryvit Systems, Inc.
   2. Parex, Inc.; a brand of ParexLahabra, Inc.
   3. TEC; an H. B. Fuller company.

2.02 MATERIALS

A. Compatibility: Provide adhesive, fasteners, board insulation, reinforcing meshes, base- and finish-coat systems, sealants, and accessories that are compatible with one another and with substrates and approved for use by manufacturer for Project.

B. Base-Coat Materials: IFS manufacturer's standard mixture complying with one of the following:
   1. Job-mixed formulation of Portland cement complying with ASTM C150/C150M, Type I, white or natural color; and manufacturer's standard polymer-emulsion adhesive designed for use with portland cement.
   2. Job-combined formulation of manufacturer's standard polymer-emulsion adhesive and manufacturer's standard dry mix containing portland cement.
   3. Factory-blended dry formulation of portland cement, dry polymer admixture, and inert fillers to which only water is added at Project site.
   4. Factory-mixed noncementitious formulation of polymer-emulsion adhesive and inert fillers that is ready to use without adding other materials.

C. Finish-Coat Materials: Manufacturer's manufacturer's standard, siliconized acrylic-based coating complying with the following:
   1. Factory-mixed formulation of polymer-emulsion binder, colorfast mineral pigments, sound stone particles, and fillers.
   2. Colors: See sub-section 3.9 IFS Schedule, below.

D. Water: Potable.

E. Trim Accessories: Type as designated or required to suit conditions indicated and to comply with IFS manufacturer's written instructions; manufactured from UV-stabilized PVC; and complying with ASTM D1784, manufacturer's standard Cell Class for use intended, and ASTM C1063.
   1. Casing Bead: Prefabricated, one-piece type for attachment behind insulation, of depth required to suit thickness of coating and insulation, with face leg perforated for bonding to coating and back leg.
   2. Drip Screed/Track: Prefabricated, one-piece type for attachment behind insulation with face leg extended to form a drip, of depth required to suit thickness of coating and insulation, with face leg perforated for bonding to coating and back leg.
   3. Expansion Joint: Prefabricated, one-piece V profile; designed to relieve stress of movement.

2.03 MIXING

A. General: Comply with Manufacturer's requirements for combining and mixing materials. Do not introduce admixtures, water, or other materials except as recommended by manufacturer. Mix materials in clean containers. Use materials within time period specified by manufacturer or discard.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of IFS.

B. Examine roof edges, wall framing, flashings, openings, substrates, and junctures at other construction for suitable conditions where IFS will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.
   1. Begin coating application only after surfaces are dry.
   2. Application of coating indicates acceptance of surfaces and conditions.

3.02 PREPARATION

A. Protect contiguous work from moisture deterioration and soiling caused by application of IFS. Provide temporary covering and other protection needed to prevent spattering of exterior finish coats on other work.

B. Protect IFS, substrates, and wall construction behind them from inclement weather during installation. Prevent penetration of moisture behind IFS and deterioration of substrates.

C. Prepare and clean substrates to comply with IFS manufacturer's written instructions to obtain optimum bond between substrate and adhesive for insulation.
   1. Concrete Substrates: Provide clean, dry, neutral-pH substrate for insulation installation. Verify suitability of substrate by performing bond and moisture tests recommended by manufacturer.

3.03 INSTALLATION, GENERAL

A. Comply with ASTM C1397 and manufacturer's written instructions for installation as applicable to each type of substrate indicated.

B. Comply with applicable recommendations provided by EIMA (EIFS Industry Members Association)

3.04 TRIM INSTALLATION

A. Trim: Apply trim accessories at perimeter of IFS, at expansion joints, and elsewhere as indicated, according to manufacturer's written instructions. Coordinate with installation of insulation.
   1. Drip Screed/Track: Use at bottom edges of IFS unless otherwise indicated.
   2. Plastic Corner/Casing Bead: Use at other locations.

3.05 BASE-COAT INSTALLATION

A. Base Coat: Apply to exposed surfaces of insulation and foam shapes in minimum thickness recommended in writing by manufacturer, but not less than 1/16-inch (1.6-mm) dry-coat thickness.

B. Reinforcing Mesh: Embed type indicated below in wet base coat to produce wrinkle-free installation with mesh continuous at corners and overlapped not less than 2-1/2 inches (64 mm) or otherwise treated at joints to comply with ASTM C 1397 and manufacturer's written instructions. Do not lap reinforcing mesh within 8 inches (204 mm) of corners. Completely embed mesh, applying additional base-coat material if necessary, so reinforcing-mesh color and pattern are not visible.
   1. Standard-impact reinforcing mesh unless otherwise indicated.

C. Additional Reinforcing Mesh: Apply strip reinforcing mesh around openings extending 4 inches (100 mm) beyond perimeter. Apply additional 9-by-12-inch (230-by-300-mm) strip reinforcing mesh diagonally at corners of openings (re-entrant corners). Apply 8-inch- (200-mm-) wide strip reinforcing mesh at both inside and outside corners unless base layer of mesh is lapped not less than 4 inches (100 mm) on each side of corners.
   1. At aesthetic reveals, apply strip reinforcing mesh not less than 8 inches (200 mm) wide.
   2. Embed strip reinforcing mesh in base coat before applying first layer of reinforcing mesh.

D. Double Base-Coat Application: Where indicated, apply second base coat in same manner and thickness as first application except without reinforcing mesh. Do not apply until first base coat has cured.

3.06 FINISH-COAT INSTALLATION

A. Finish Coat:
   1. Apply over dry base coat, maintaining a wet edge at all times for uniform appearance, in thickness required by manufacturer to produce a uniform finish of color and texture matching approved sample and free of cold joints, shadow lines, and texture variations.
   2. Do not apply finish coat into or over sealant joints; apply to outside of wall only.

3.07 CLEANING AND PROTECTION

A. Remove temporary covering and protection of other work. Promptly remove coating materials from window and door frames and other surfaces outside areas indicated to receive IFS coatings.

3.08 IFS SCHEDULE

A. IFS-1 (**NOT USED)** (Interior)
   1. Substrate: Sheathing or Concrete
   2. System: Senerflex Interior Finish System
   3. Base-Coat Materials: Senergy Xtra-Stop Base Coat
   4. Reinforcing Mesh: Standard-Impact Reinforcing Mesh
   5. Finish-Coat Materials: Senergy Siliconite Finish Coat
   6. Texture: Senergy Sahara., or Dryvit “Sand Pebble” Texture
   7. Color: Custom color to match Sherwin Williams, SW 7695 Mesa Tan
   8. Location: Interior Pool Deck, See Drawings
   9. URL: https://www.sherwin-williams.com/homeowners/color/find-and-explore-colors/paint-colors-by-family/SW7695-mesa-tan

B. **IFS-2**
   1. Manufacturer: Dryvit System, Inc.
   2. Product: Interior Architectural Coating, DS174
   3. Texture: Sand Pebble
   4. Color: Custom to match Benjamin Moore HC-173 Edgecomb Gray
   5. Sealer: Manufacturer’s waterproof, clear acrylic-based sealer for protecting finish coat
   6. Finish coat shall be applied 1/16 inch thick
   7. Location: Interior Pool Deck, See Drawings
   8. URL: https://www.benjaminmoore.com/en-us/color-overview/find-your-color/color/hc-173/edgecomb-gray?color=HC-173

C. IFS-3 (**NOT USED)**
   1. Manufacturer: Parex
   2. Product: Parex Acrylic Finish
   3. Texture: Sand Fine LB
   4. Color: Custom to match SW 7567 – 179196 Natural Tan
   5. Colorante: Colortrend 888
   6. Primer: Manufacturer’s waterproof, 20114 coat
   7. Finish coat shall be applied 1/16 inch thick
   8. Location: Roof Pool Deck, See Drawings
   9. URL: https://www.sherwin-williams.com/homeowners/color/find-and-explore-colors/paint-colors-by-family/SW7567-natural-tan

D. IFS-4 (**NOT USED)**
   1. Manufacturer: Dryvit System, Inc.
   2. Product: Interior Architectural Coating, DS174
   3. Texture: Finesse
   4. Color: Custom to match Benjamin Moore OC-24 Winds Breath
   5. Sealer: Manufacturer’s waterproof, clear acrylic-based sealer for protecting finish coat
   6. Finish coat shall be applied 1/16 inch thick

7. Location: Interior Pool Deck, See Drawings
8. URL: https://www.benjaminmoore.com/en-us/color-overview/find-your-color/color/oc-24/winds-breath?color=OC-24

E. IFS-5 (**NOT USED)**
1. Manufacturer: Dryvit System, Inc.
2. Product: Interior Architectural Coating, DS174
3. Texture: Finesse
4. Color: Custom to match Sherwin Williams 7061 Night Owl (PT-23)
5. Sealer: Manufacturer's waterproof, clear acrylic-based sealer for protecting finish coat
6. Finish coat shall be applied 1/16 inch thick
7. Location: Interior Pool Deck, See Drawings
8. URL: https://www.benjaminmoore.com/en-us/color-overview/find-your-color/color/oc-24/winds-breath?color=OC-24

END OF SECTION

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SECTION 07 27 00

SHEET-APPLIED MEMBRANE AIR BARRIERS (VAPOR IMPERMEABLE)

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:

1. Materials and installation methods for sheet-applied, vapor impermeable air barrier membrane system located in the non-accessible part of the wall.
2. Materials and installation methods to bridge and seal air leakage pathways in roof and foundation junctions, window and door openings, control and expansion joints, masonry ties, piping and other penetrations through the wall assembly.

B. Related Sections include the following:

1. Section 03 30 00 – Cast-In-Place Concrete
2. Section 04 20 00 – Unit Masonry
3. Section 07 13 25 – Self-Adhering Sheet Waterproofing
4. Section 07 62 00 – Sheet Metal Flashing and Trim
5. Section 07 92 00 – Joint Sealants
6. Section 09 21 16 – Gypsum Board Assemblies

1.03 DEFINITIONS

A. Air Barrier Assembly: The collection of air barrier materials and auxiliary materials applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.04 PERFORMANCE REQUIREMENTS

A. General: Air barrier shall be capable of performing as a continuous vapor-impermeable air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

B. The building envelope shall be designed and constructed with a continuous air barrier to control air leakage into, or out of the conditioned space. An air barrier shall also be provided for interior partitions between conditioned space and space designed to maintain temperature or humidity levels which differ from those in the conditioned space by more than 50% of the difference between the conditioned space and design ambient conditions. The air barrier shall have the following characteristics:

1. It must be continuous, with all joints made airtight.
2. It shall have an air permeability not to exceed 0.004 cfm/sq. ft. under a pressure differential of 0.3 in. water (1.57 psf) (equal to 0.02 L/s. x sq. m. @ 75 Pa), when tested in accordance with ASTM E2178.
3. It shall have an air permeability not to exceed 0.04 cfm/sq. ft. under a pressure differential of 0.3 in. water (1.57 psf) (equal to 0.2 L/s. x sq. m. @ 75 Pa), when tested in accordance with ASTM E2357.
4. It shall be capable of withstanding positive and negative combined design wind, fan and stack pressures on the envelope without damage or displacement, and shall transfer the load to the structure. It shall not displace adjacent materials under full load.
5. It shall be durable or maintainable.
6. The air barrier shall be joined in an airtight and flexible manner to the air barrier material of adjacent systems, allowing for the relative movement of systems due to thermal and moisture variations and creep. Connection shall be made between:

    a. Foundation and walls
    b. Walls and windows or doors
    c. Different wall systems
    d. Wall and roof
    e. Wall and roof over unconditioned space
    f. Walls, floor and roof across construction, control and expansion joints
    g. Walls, floors and roof to utility, pipe and duct penetrations

7. All penetrations of the air barrier and paths of air infiltration/exfiltration shall be made airtight.

1.05 REFERENCES

A. The following standards and publications are applicable to the extent referenced in the text. The most recent version of these standards is implied unless otherwise stated.

B. American Society for Testing and Materials (ASTM) and National Fire Protection Association (NFPA)

1. ASTM C1193 Guide for Use of Joint Sealants
2. ASTM D412 Standard Test Methods for Rubber Properties in Tension
3. ASTM D570 Standard Test Method for Water Absorption of Plastics
4. ASTM D1004 Standard Test Method for Tear Resistance (Graves Tear) of Plastic Film and Sheeting
5. ASTM D1876 Test Method for Peel Resistance of Adhesives
6. ASTM D1938 Standard Test Method for Tear-Propagation Resistance (Trouser Tear) of Plastic Film and Thin Sheeting by a Single-Tear Method
7. ASTM D1970 Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection
8. ASTM D4258 Practice for Surface Cleaning Concrete for Coating
9. ASTM D4263 Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method
10. ASTM D4541 Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
11. ASTM E96 Test Methods for Water Vapor Transmission of Materials
12. ASTM E154 Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover
13. ASTM E1186 Practice for Air Leakage Site Detection in Building Envelopes and Air Retarder Systems

14. ASTM E2178 Standard Test Method for Air Permeance of Building Materials
15. ASTM E2357 Standard Test Method for Determining Air Leakage of Air Barrier Assemblies
16. NPFA 285 Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components

1.06 SUBMITTALS

A. Product Data: Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties of air barrier.

B. Shop Drawings: Show locations and extent of air barrier. Include details for substrate joints and cracks, counterflashing strip, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.

1. Include details of interfaces with other materials that form part of air barrier
2. Include details of mockups

C. Samples: Submit representative samples of the following for approval:

1. Sheet-Applied membrane
2. Self-Adhered Transition Membrane
3. Self-Adhered Through Wall Flashing

D. Product Certificates: For air barriers, certifying compatibility of air barrier and accessory materials with project materials that connect to or that come in contact with the barrier; signed by product manufacturer.

E. Qualification Data: For Applicator.

F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for air barriers, submit certified test report showing compliance with requirements specified for ASTM E2178.

G. Warranty: Submit a sample warranty identifying the terms and conditions stated in Article 1.10.

1.07 QUALITY ASSURANCE

A. Manufacturer: Air barrier systems shall be manufactured and marketed by a firm with a minimum of 20 years experience in the production and sales of waterproofing and air barriers. Manufacturers proposed for use, but not named in these specifications shall submit evidence of ability to meet all requirements specified, and include a list of projects of similar design and complexity completed within the past five years.

B. Source Limitations: Obtain primary air-barrier material and all air barrier assembly materials through one source from a single manufacturer. Should project require a vapor permeable and a vapor impermeable air barrier on same project, obtain vapor-permeable and vapor impermeable air barrier and through wall flashing from one source from a single manufacturer. See specification Section 072727 for fully-adhered vapor permeable air barrier.

C. Applicator Qualifications: A firm experienced in applying air barrier materials similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.

D. Mockups: Before beginning installation of air barrier, provide air barrier work for exterior wall assembly mockups, incorporating backup wall construction, external cladding, window, door frame and sill, insulation, and flashing to demonstrate surface preparation, crack and joint treatment, and sealing of gaps, terminations, and penetrations of air barrier membrane.

1. Coordinate construction of mockup to permit inspection by Owner's testing agency of air barrier before external insulation and cladding is installed
2. If Architect determines mockups do not comply with requirements, reconstruct mockups and apply air barrier until mockups are approved

E. Pre-Installation Conference: A pre-installation conference shall be held prior to commencement of field operations to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work. Preinstallation conference shall include the Contractor, installer, Architect, and system manufacturer's field representative. Agenda for meeting shall include but not be limited to the following:

1. Review of submittals
2. Review of surface preparation, minimum curing period and installation procedures
3. Review of special details and flashings
4. Sequence of construction, responsibilities and schedule for subsequent operations
5. Review of mock-up requirements
6. Review of inspection, testing, protection and repair procedures

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials and products in labeled packages. Store and handle in strict compliance with manufacturer’s instructions, recommendations and material safety data sheets. Protect from damage from sunlight, weather, excessive temperatures and construction operations. Remove damaged material from the site and dispose of in accordance with applicable regulations.

B. Do not double-stack pallets of sheet applied membrane components on the job site. Provide cover on top and all sides, allowing for adequate ventilation.

C. Protect sheet-applied membrane components from freezing and extreme heat.

D. Sequence deliveries to avoid delays, but minimize on-site storage.

1.09 PROJECT CONDITIONS

A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended by air barrier manufacturer. Protect substrates from environmental conditions that affect performance of air barrier. Do not apply air barrier to a wet substrate or during snow, rain, fog, or mist.

1.10 WARRANTY

A. Submit manufacturer's warranty that air barrier and accessories are free of defects at time of delivery and are manufactured to meet manufacturer's published physical properties and material specifications.

B. Warranty Period: Five years from date of completion of the air barrier membrane installation.

PART 2 PRODUCTS

2.01 SHEET-APPLIED, VAPOR IMPERMEABLE MEMBRANE AIR BARRIER

A. SHEET-APPLIED AIR BARRIER MEMBRANE: Perm-A-Barrier® NPS, as manufactured by GCP Applied Technologies; 0.012-inch adhesive, 0.004 inch HDPE / AL, sheet-applied, vapor impermeable membrane that forms a resilient, monolithic, fully bonded elastomeric membrane when applied to construction surfaces. The membrane provides superior protection against the damaging effects of air and liquid water ingress on the building structures. Product shall meet the following requirements:

1. Membrane Air Permeance: ASTM E2178: Not to exceed 0.004 cfm/sq. ft. under a pressure differential of 0.3 in. water (1.57 psf) (equal to 0.02 L/s. x sq. m. @ 75 Pa)
2. Assembly Air Permeance: Provide a continuous air barrier assembly that has an air leakage not to exceed 0.04 cfm/sq. ft. of surface area under a pressure differential of 0.3 in. water (1.57 psf) (equal to 0.2 L/s. x sq. m. of surface area at 75 Pa) when tested in accordance with ASTM E2357.
3. Water Resistance: ASTM E331: Pass.
4. Water Vapor Permeance: ASTM E96, Method A: < 1 perm
5. Water Vapor Permeance: ASTM E96, Method B: < 1 perm
6. Elongation: ASTM D412-Die C: minimum 200%
7. Low temperature flexibility and crack bridging: ASTM C1305: Pass.
8. Nail sealability: ASTM D1970: Pass
9. Fire Resistance: Evaluated to NFPA 285 as part of various wall assemblies

B. TRANSITION MEMBRANE: Perm-A-Barrier Detail Membrane manufactured by GCP Applied Technologies; a 0.9 mm (36 mils) of self-adhesive rubberized asphalt integrally bonded to 0.1 mm (4 mil) of cross-laminated, high-density polyethylene film to provide a min. 1.0 mm (40 mil) thick membrane. Membrane shall be interleaved with disposable silicone-coated release paper until installed, conforming with the following:

1. Water Vapor Transmission: ASTM E96, Method B: 0.05 perms (2.9 ng/Pa s. sq. m.) maximum
2. Air Permeance at 75 Pa (0.3 in. water) pressure difference: 0.0006 L/s. sq. m (0.00012 cfm/ sq. ft.) maximum
3. Puncture Resistance: ASTM E154: 178 N (40 lbs.) minimum
4. Lap Adhesion at minus 4 degrees Celsius (25 degrees Fahrenheit): ASTM D1876: 880 N/m (5.0 lbs./in.) of width

5. Low Temperature Flexibility: ASTM D1970: Unaffected to minus 43 degrees Celsius (minus 45 degrees Fahrenheit)
6. Tensile Strength: ASTM D412, Die C Modified: minimum 2.7 MPa (400 psi)
7. Elongation, Ultimate Failure of Rubberized Asphalt: ASTM D412, Die C: minimum 200%

C. TRANSITION ALUMINUM MEMBRANE: Perm-A-Barrier Aluminum flashing manufactured by GCP Applied Technologies; a 0.9 mm (35 mils) of self-adhesive rubberized asphalt integrally bonded to 0.1 mm (5 mil) of aluminum film to provide a min. 1.0 mm (40 mil) thick membrane. Membrane shall be interleaved with disposable silicone-coated release paper until installed, conforming with the following:

1. Water Absorption: ASTM D570: max 0.1% by weight
2. Puncture Resistance: ASTM E154: 355N (80 lbs) min.
3. Lap Adhesion at minus 4 degrees Celsius (25 degrees Fahrenheit): ASTM D1876 Modified: 880 N/m (5.0 lbs./in.) of width
4. Low Temperature Flexibility: ASTM D1970 Modified: Unaffected to minus 26 degrees Celsius (minus15 degrees Fahrenheit)
5. Tensile Strength: ASTM D412, Die C Modified: minimum 4.1 MPa (600 Psi)
6. Elongation, Ultimate Failure of Rubberized Asphalt: ASTM D412, Die C Modified: minimum 200%

D. FLEXIBLE MEMBRANE THRU-WALL FLASHING: Perm-A-Barrier Wall Flashing manufactured by GCP Applied Technologies; a 0.8 mm (32 mils) of self-adhesive rubberized asphalt integrally bonded to 0.2 mm (8 mil) of cross-laminated, high-density polyethylene film to provide a min. 1.0 mm (40 mil) thick membrane. Membrane shall be interleaved with disposable silicone-coated release paper until installed, conforming with the following:

1. Water Vapor Transmission: ASTM E96, Method B: 0.05 perms (2.9 ng/ Pa s. sq. m.) maximum
2. Water Absorption: ASTM D570: max. 0.1% by weight
3. Puncture Resistance: ASTM E154: 356 N (80 lbs.) minimum
4. Tear Resistance
    a. Initiation, ASTM D1004: min. 58 N (13.0 lbs.) M.D.
    b. Propagation, ASTM D1938: min. 40 N (9.0 lbs.) M.D.
5. Lap Adhesion at minus 4 degrees Celsius (25 degrees Fahrenheit): ASTM D1876: 880 N/m (5.0 lbs./in.) of width
6. Low Temperature Flexibility: ASTM D1970: Unaffected to minus 43 degrees Celsius (minus 45 degrees Fahrenheit)
7. Tensile Strength: ASTM D412, Die C Modified: minimum 5.5 MPa (800 psi)
8. Elongation, Ultimate Failure of Rubberized Asphalt: ASTM D412, Die C: minimum 200%

E. HIGH TEMPERATURE TRANSITION MEMBRANE: Perm-A-Barrier Ultra manufactured by GCP Applied Technologies; a 25 mil (0.635 mm) of self-adhesive butyl integrally bonded to 5 mil (0.127 mm) of high-density polyethylene film laminated to aluminum facer to provide a min. 30 mil (0.76 mm) thick robust membrane. Membrane shall be interleaved with disposable silicone-coated release paper until installed, conforming to the following:

1. Heat Resistance, 300°F (149°C)
2. Tensile Strength, ASTM D882: 5000 psi (34.5 MPa)
3. Elongation, membrane, ASTM D882: 200%
4. Adhesion to gypsum sheathing, ASTM D903: 5.0 lbs/in.

2.02 PRIMERS – Required for some applications below 25°F

A. Primer for Self-Adhered Transition Membrane and Flexible Membrane Wall Flashing: Perm-A-Barrier WB Primer manufactured by GCP Applied Technologies; a water-based primer which imparts an aggressive, high tack finish on the treated substrate.

1. Flash Point: No flash to boiling point
2. VOC Content: Not to exceed 10 g/L
3. Application Temperature: minus 4 degrees Celsius (25 degrees Fahrenheit) and above
4. Freezing point (as packaged): minus 7 degrees Celsius (21 degrees Fahrenheit)

2.03 PENETRATIONS & TERMINATION SEALANT

A. Liquid Membrane for Details and Terminations and Substrate Patching: Bituthene Liquid Membrane manufactured by GCP Applied Technologies; a two-part, elastomeric, trowel grade material designed for use with SHEET-applied membranes, self-adhered membranes and tapes. 10 g/L maximum VOC content.

B. Sealant for Details, Final Terminations and Sheathing: Perm-A-Barrier Universal Flashing & Sealant manufactured by GCP Applied Technologies: a one-part, moisture curing, STPE material designed for use with SHEET-applied membranes, self-adhered membrane and tapes.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrates and conditions are ready to accept the Work of this section. Notify [engineer] [architect] [consultant] in writing of any discrepancies. Commencement of the Work or any parts thereof shall mean acceptance of the prepared substrates.

B. All surfaces must be sound, dry, clean and free of oil, grease, dirt, excess mortar or other contaminants detrimental to the adhesion of the membranes. Fill voids, gaps and spalled areas in substrate to provide an even plane. Strike masonry joints full-flush.
Curing compounds or release agents used in concrete construction must be resin based without oil, wax or pigments.

3.02 SURFACE PREPARATION

A. Refer to manufacturer's literature for requirements for preparation of substrates. Surfaces shall be sound and free of voids, spalled areas, loose aggregate and sharp protrusions. Remove contaminants such as grease, oil and wax from exposed surfaces. Remove dust, dirt, loose stone and debris. Use repair materials and methods that are acceptable to manufacturer of the SHEET-applied air barrier assembly.

B. Exterior sheathing panels: Ensure that the boards are sufficiently stabilized with corners and edges fastened with appropriate screws.

C. Masonry Substrates: Apply air and vapor barrier over concrete block and brick with smooth trowel-cut mortar joints, struck full and flush. Fill all voids and holes, particularly in the mortar joints, with a lean mortar mix, non-shrinking grout or parge coat.

D. Related Materials: Treat construction joints and install flashing as recommended by manufacturer.

E. Clean, prepare, treat, and seal substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air barrier application.

F. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.

G. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

H. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate patching membrane.

I. Remove excess mortar from masonry ties, shelf angles, and other obstructions.

J. At changes in substrate plane, apply Bituthene Liquid Membrane at sharp corners and edges to form a smooth transition from one plane to another.

K. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

3.03 JOINT TREATMENT

A. Concrete and Masonry: Prepare, treat, rout, and fill joints and cracks in substrate according to ASTM C1193 and air barrier manufacturer's written instructions. Remove dust and dirt from joints and cracks complying with ASTM D4258 before coating surfaces.

3.04 AIR BARRIER MEMBRANE INSTALLATION

A. Apply air barrier membrane to achieve a continuous air barrier according to air barrier manufacturer's written instructions.

B. Apply air barrier membrane within manufacturer's recommended application temperature ranges.

C. Do not cover air barrier until it has been tested and inspected by Owner's testing agency.

D. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air barrier components.

3.05 PREFABRICATED WINDOW CORNER INSTALLATION

A. Install prefabricated window corners into rough openings of windows at bottom corners of the window openings prior to installing primer and transition membrane. Install the corners into the rough opening in accordance with manufacturer’s installation instructions.

3.06 TRANSITION MEMBRANE INSTALLATION

A. Install strips, transition membrane, and auxiliary materials according to air barrier manufacturer's written instructions to form a seal with adjacent construction and maintain a continuous air barrier.

B. Apply primer to substrates to receive transition membrane at required rate and allow to dry. Limit priming to areas that will be covered by transition tape in same day. Re-prime areas exposed for more than 24 hours.

1. Prime glass-fiber-surfaced gypsum sheathing not covered with air membrane material with number of prime coats needed to achieve required bond, with adequate drying time between coats.

C. Connect and seal exterior wall air barrier membrane continuously to roofing membrane air barrier, concrete below-grade structures, floor-to floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.

D. At end of each working day, seal top edge of strips and transition membrane to substrate with termination sealant.

E. Apply joint sealants forming part of air barrier assembly within sealant manufacturer's recommended application temperature ranges. Consult sealant manufacturer when sealant cannot be applied within these temperature ranges.

1. Wall Openings: Prime concealed perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply transition membrane so that a minimum of 3 inches (75 mm) of coverage is achieved over both substrates. Roll firmly to enhance adhesion.

F. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air barrier membrane with foam sealant.

G. Repair punctures, voids, and deficient lapped seams in strips and transition membrane. Slit and flatten fish-mouths and blisters. Patch with transition membrane extending 6 inches (150 mm) beyond repaired areas in strip direction.

3.07 FIELD QUALITY CONTROL

A. Testing Agency: Owner may engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. Inspections: Air barrier materials and installation are subject to inspection for compliance with requirements. Inspections may include the following:

1. Continuity of air barrier system has been achieved throughout the building envelope with no gaps or holes
2. Continuous structural support of air barrier system has been provided
3. Masonry and concrete surfaces are smooth, clean and free of cavities, protrusions, and mortar droppings
4. Site conditions for application temperature and dryness of substrates have been maintained
5. Maximum exposure time of materials to UV deterioration has not been exceeded
6. Surfaces have been primed, if applicable

7. Laps in strips and transition membrane have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fish-mouths
8. Termination sealant has been applied on cut edges
9. Strips and transition membrane have been firmly adhered to substrate
10. Compatible materials have been used
11. Transitions at changes in direction and structural support at gaps have been provided.
12. Connections between assemblies (membrane and sealants) have complied with requirements for cleanliness, preparation and priming of surfaces, structural support, integrity, and continuity of seal
13. All penetrations have been sealed

C. Tests: Testing to be performed will be determined by Owner's testing agency from among the following tests:

1. Qualitative Testing: Air barrier assemblies will be tested for evidence of air leakage according to ASTM E1186.

D. Remove and replace deficient air barrier components and retest as specified above.

3.08 CLEANING AND PROTECTION

A. Protect air barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.

B. Protect air barrier from exposure to UV light and harmful weather exposure as required by manufacturer. Remove and replace main air barrier material exposed for more than 12 months.

C. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended by manufacturer of affected construction.

D. Remove masking materials after installation.

END OF SECTION

SECTION 07 27 26
FLUID-APPLIED MEMBRANE AIR BARRIERS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Fluid-applied membrane air barrier, vapor retarding.
      a. Alternate section for

1.02 RELATED SECTIONS

A. Section 01 33 00 - Submittal Procedures
B. Section 01 40 00 - Quality Requirements
C. Section 01 45 33 - Code-Required Special Inspections and Procedures
D. Section 01 60 00 - Product Requirements
E. Section 03 30 00 - Cast in Place Concrete
F. Section 03 45 00 - Precast Architectural Concrete
G. Section 03 45 70 - Architectural Site Cast Concrete Wall Panels
H. Section 04 20 00 - Unit Masonry
I. Section 07 08 00 - Commissioning of Thermal and Moisture Protection
J. Section 07 21 00 - Thermal Insulation
K. Section 07 24 19 - Water Drainage Exterior Insulation and Finish System (EIFS)
L. Section 07 42 00 - Metal Wall Panels
M. Section 07 92 00 - Joint Sealants
N. Section 09 21 16 - Gypsum Board Assemblies

1.03 REFERENCE STANDARDS

A. ANSI A118.10 - American National Standard Specifications for Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation; 2023.
B. ANSI A118.12 - American National Standard Specifications for Crack Isolation Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation; 2014 (Reaffirmed 2019).
C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
D. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016 (Reapproved 2023).
E. ASTM D4263 - Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method; 1983 (Reapproved 2018).
F. ASTM E2357 - Standard Test Method for Determining Air Leakage Rate of Air Barrier Assemblies; 2024.

1.04 SUBMITTALS

A. Product Data: Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties of air barrier.
   1. Include all accessory material data.
B. Shop Drawings: Show locations and extent of air barrier. Include details for substrate joints and cracks, counterflashing strip, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
   1. Include details of interfaces with other materials that form part of air barrier.
   2. Include details of mock-ups.
C. Compatibility Letters:

1. Submit letters from the Manufacturer ensuring compatibility with adjacent materials, including Waterproofing, EIFS, sealants, etc.

D. Procurement:
1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
2. Submit inventory to Owner within 5 days of delivery of materials.
3. See Sections 01 33 00 and 01 60 00.

1.05 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Applicator Qualifications: Company experienced in applying air barrier materials similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.

C. Mockup: See drawings for requirements for Mockup.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store liquid materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by air barrier manufacturer.

B. Remove and replace liquid materials that cannot be applied within their stated shelf life.

C. Store rolls per manufacturer's written instructions.

D. Store materials at Project site in a cool, dry location, out of direct sunlight, protected from inclement weather and other sources of damage. Minimum storage temperature shall be 40 degrees F (4 degrees C).

1.07 PROJECT CONDITIONS

A. Environmental Limitations: Apply air barrier within range of ambient and substrate temperatures recommended by air barrier manufacturer. Protect substrates from environmental conditions that affect performance of air barrier. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.
1. Do not apply wet materials during inclement weather unless appropriate protection is provided. Protect materials from inclement weather until they are completely dry.
2. At time of application, minimum air and wall surface temperatures shall be 40 degrees F (4 degrees C).and rising. Maintain these temperatures, with adequate air ventilation and circulation, for a minimum of 12 hours thereafter, or until products are dry.

PART 2 PRODUCTS

2.01 FLUID-APPLIED MEMBRANE AIR BARRIER

A. General: Provide products that are certified to be compatible by manufacturer of substrate.

B. Air and Water-Resistive Barrier Components:
1. Acceptable Product: Subject to compliance with requirements, provide Tremco ExoAir 130 (impermeable) and ExoAir 230 (permeable).
2. Barrier Membrane: Flexible, polymer-based, noncementitious, water-resistive coating.
a. Finish Surface: Smooth.
3. Grid Tape: Open weave fiberglass mesh tape with pressure sensitive adhesive in rolls 4 inch (102 mm) wide by 100 yards (91 m) long.

C. Load Bearing Fluid Applied Membrane Air Barrier:
1. General: Load bearing membrane, for the application of adhered masonry or tile.
a. Meet or exceed requirements ANSI A118.10, ANSI A118.12 for adhered masonry or tile.
b. Meet or exceed requirements of ASTM E2357 for air barrier assemblies.
c. Compatible with products specified for adhered tile and masonry assemblies, see Sections 04 20 00 and 09 30 00.
2. Manufacturer and Product:

a. Same as Manufacturer listed above.

D. Flashing Materials: Used to protect substrate edges at terminations.
1. All Liquid Applied and Sheet flashings shall be provided by Manufacturer of the Air/ WRB.

2.02 AUXILIARY MATERIALS

A. General: Auxiliary materials recommended by air barrier manufacturer for intended use and compatible with air barrier membrane. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.

B. Modified Bituminous Strip: Vapor-retarding, 40 mil (1.0 mm) thick, smooth-surfaced, self-adhering; consisting of 36 mils (0.9 mm) of rubberized asphalt laminated to a 4 mil (0.1 mm) thick polyethylene film with release liner backing.

C. Butyl Strip: Vapor-retarding, 30 to 40 mil (0.76 to 1.0 mm) thick, self-adhering; polyethylene-film-reinforced top surface laminated to layer of butyl adhesive with release liner backing.
1. For use with vapor-permeable barrier.

D. Adhesive-Coated Transition Strip: Vapor-permeable, 17 mil (0.43 mm) thick, self-adhering strip consisting of an adhesive coating over a permeable laminate with a permeance of 37 perms (2145 ng/Pa x s x sq. m).

E. Joint Reinforcing Strip: Air barrier manufacturer's glass-fiber-mesh tape.

F. Joint Sealant: ASTM C920, single-component, neutral-curing silicone; Class 100/50 (low-modulus), Grade NS, Use NT related to exposure, and, as applicable to joint substrates indicated, Use O. Comply with Section 07 92 00 – Joint Sealants.
1. Acceptable Product: LM 800XL by Carlislefor joints and terminations.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
2. Verify that concrete has cured and aged for minimum time period recommended by air-barrier manufacturer.
3. Verify that concrete is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D4263.
4. Verify that masonry joints are flush and completely filled with mortar.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 SURFACE PREPARATION

A. Clean, prepare, treat, and seal substrate per manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air-barrier application.

B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.

C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching membrane.

E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.

F. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

G. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

3.03 JOINT TREATMENT

A. Concrete and Masonry: Prepare, treat, rout, and fill joints and cracks in substrate per ASTM C1193 and air barrier manufacturer's written instructions.

B. Gypsum Sheathing: Fill joints greater than 1/4 inch (6 mm) with sealant per ASTM C1193 and with air barrier manufacturer's written instructions. Apply first layer of fluid air barrier membrane at joints. Tape joints with joint reinforcing strip after first layer is dry. Apply a second layer of fluid air barrier membrane over joint reinforcing strip.

3.04 TRANSITION STRIP INSTALLATION

A. Install strips, transition strips, and auxiliary materials per air-barrier manufacturer's written instructions to form a seal with adjacent construction and maintain a continuous air-barrier.
   1. Coordinate installation of air-barrier with installation of roofing membrane and base flashing to ensure continuity of air-barrier with roofing membrane.
   2. Install butyl (transitions to roof membrane) strip on roofing membrane or base flashing so that a minimum of 3 inches (76 mm) of coverage is achieved over both substrates.

B. Apply primer to substrates at required rate and allow to dry. Limit priming to areas that will be covered by air-barrier sheet in same day. Reprime areas exposed for more than 24 hours.
   1. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.

C. Connect and seal exterior wall air-barrier membrane continuously to roofing membrane air-barrier, concrete below-grade structures, floor-to floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.

D. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.

E. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

F. Seal top of through-wall flashings to air-barrier with an additional 6 inch (152 mm) wide strip as recommended by air-barrier manufacturer.

G. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.

H. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches (152 mm) beyond repaired areas in strip direction.

3.05 MEMBRANE INSTALLATION

A. Smooth Surface Finish: Apply smooth surface material per system manufacturer's published instructions.
   1. Mix materials with equipment and for duration recommended by system manufacturer.
   2. Prior to application of finish surface, apply strip of grid tape over sheathing joints, including inside and outside corners, and trowel apply layer of texture finish over grid tape. Spot cover fastener heads.
   3. Apply finish to substrate using a trowel, roller, or spray equipment, depending on substrate, and backroll. Apply membrane to achieve uniform thickness over wall area. Measure thickness of membrane during installation to confirm minimum thickness is being met.
   4. Apply smooth finish over entire wall surface, including previously treated joints and fasteners.
   5. Allow material to dry a minimum of 4 hours prior to application of flashing liquid or tape, and adhesively applied EPS insulation board. Cool damp weather will require longer drying times. During cool damp weather, flashing tape surface conditioner may be necessary for proper flashing tape adhesion. Protect fluid applied waterproofing from exposure to precipitation and damage until membrane is fully cured.

6. Install specified Exterior Insulation and Finish System per published installation instructions for specific system being used.

3.06 CLEANING

A. Clean spills, stains, and soiling from construction that would be exposed in completed Work using cleaning agents and procedures recommended by manufacturer of affected construction.

B. Remove masking materials after installation.

3.07 PROTECTION

A. Protect air barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.
   1. Protect air barrier from exposure to UV light and harmful weather exposure as required by manufacturer. Remove and replace air barrier exposed for more than 30 days.
   2. Protect air barrier from contact with creosote, uncured coal-tar products, TPO, EPDM, flexible PVC membranes, and sealants not approved by air barrier manufacturer.

END OF SECTION

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SECTION 07 42 00
METAL WALL PANELS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Factory-formed and assembled, composite metal wall panels.
   2. Factory-formed and finished modular metal wall panels.
   3. Metal Soffit Panels.
   4. Thermal bridging clips.

1.02 RELATED SECTIONS

A. Section 01 33 00 - Submittal Procedures.

B. Section 01 40 00 - Quality Requirements.

C. Section 01 60 00 - Product Requirements.

D. Section 04 20 00 - Unit Masonry.

E. Section 07 08 00 - Commissioning of Thermal and Moisture Protection.

F. Section 07 21 00 - Thermal Insulation

G. Section 07 27 00 - Sheet-Applied Membrane Air Barriers

H. Section 07 54 24 - Thermoplastic Polyolefin (TPO) Roofing.

I. Section 07 62 00 - Sheet Metal Flashing and Trim.

J. Section 10 14 00 - Signage.

1.03 REFERENCE STANDARDS

A. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus; 2019.

B. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.

C. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2020.

D. ASTM D1005 - Standard Test Method for Measurement of Dry-Film Thickness of Organic Coatings Using Micrometers; Current Edition.

E. ASTM D1308 - Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Coating Systems; 2020.

F. ASTM D1400 - Standard Test Method for Tear Resistance (Graves Tear) of Plastic Film and Sheeting; Current Edition.

G. ASTM D1781 - Standard Test Method for Climbing Drum Peel for Adhesives; 1998 (Reapproved 2021).

H. ASTM D4138 - Standard Practices for Measurement of Dry Film Thickness of Protective Coating Systems by Destructive, Cross-Sectioning Means; Current Edition.

I. ASTM D5796 - Standard Test Method for Measurement of Dry Film Thickness of Thin-Film Coil-Coated Systems by Destructive Means Using a Boring Device; Current Edition.

J. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

K. ASTM E108 - Standard Test Methods for Fire Tests of Roof Coverings; 2020a.

L. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).

M. ASTM G87 - Standard Practice for Conducting Moist SO2 Tests; Current Edition.

N. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).

O. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).

P. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components; 2025.

Q. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

R. UL 94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances; Current Edition, Including All Revisions.

1.04 SYSTEM DESCRIPTION

A. Performance Requirements:
   1. Structural Performance: Capable of withstanding the effects of gravity loads and the following loads and stresses, based on testing per ASTM E330/E330M.
   2. Wind Loads: Design wind pressures shall be based on Basic Wind Speed, Risk Category, Exposure Category, and Internal Pressure Coefficient indicated on Structural Drawings.
   3. Snow Load: Design snow load shall be based on snow load parameters found in the Structural Drawings.
   4. Dead Load, Live Load: As required by applicable building code.
   5. Thermal Movements: Provide assemblies that allow for thermal movements resulting from maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components and other detrimental effects:
      a. Temperature Change (range): 120 deg F (64 deg C), ambient; 180 deg F (100 deg C), material surfaces.
      b. Sealed joints shall allow free and silent movement of panels during expansion and contraction while preventing uncontrolled penetration of moisture.
      c. Manufacturing, installation and sealing shall prevent deformation of exposed surfaces.
      d. Design panel system to accommodate substructure tolerance of +0 to -1/8 inch.
      e. Not Permitted: Vibration harmonics; wind whistles; noises caused by thermal movement transmitted to other building elements; loosening, weakening or fracturing of attachments or components of system.
   6. Joints: Dry Joint System

1.05 SUBMITTALS

A. Product Data: For each type of metal wall panel and accessory indicated.

B. Shop Drawings: Show layouts of metal wall panels, including plans, elevations, sections, details, and attachments to other Work.
   1. For Metal Panels: include details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories.
   2. Calculations: Signed and Stamped by Engineer licensed in the State where the Project is located, certifying the assembly will withstand design loads. See Structural Drawings.
   3. Indicate how girts are sealed.
   4. Indicate how drainage is maintained at base and soffit location conditions.

C. Coordination Drawings: Drawn to scale and coordinating metal wall panel installation with penetrations and wall-mounted items.

D. Samples for Verification: Of each type of metal finish required, prepared on samples of same thickness and material indicated for final work.

E. Quality Assurance Submittals: Submit the following:
   1. Certificates: Product certificates signed by manufacturer certifying materials comply with the specified performance characteristics and criteria, and physical requirements.
   2. Weld Strength Calculations shall be stamped and signed by a professional engineer specializing in the application of welding technology.
   3. Installer Qualifications: Acceptable to manufacturer.

F. Procurement:

1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
2. Submit inventory to Owner within 5 days of delivery of materials.
3. See Sections 01 33 00 and 01 60 00.

1.06 QUALITY ASSURANCE

A. Installer's responsibilities include fabricating and installing metal wall panel assemblies and providing professional engineering services needed to assume engineering responsibility.

1.07 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal wall panel assemblies that fail in materials or workmanship within specified warranty period.
   1. Failures include the following:
      a. Structural failures including rupturing, cracking, or puncturing.
      b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
   2. Warranty Period: 2 years from date of Substantial Completion.
   3. The contractor shall warrant the materials to be free of faults and defects in accordance with the General Conditions, except that the warranty shall be extended by paint manufacturer’s standard multi-year warranty. The warranty shall be in writing and shall be signed by the manufacturer.

B. Material Finish Warranty:
   1. Failures include the following:
      a. Cracking.
      b. Fading or discoloration beyond normal weathering.
      c. Chalking.
      d. Flaking.
   2. Warranty Period: 20 years from Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with requirements, provide products from 1 of the following manufacturers:
   1. Atas International Inc.
   2. Alpolic.
   3. Protean.
   4. Alucobond USA.
   5. Metal Sales Manufacturing Corporation.
   6. Or approved substitution.

2.02 MISCELLANEOUS METAL FRAMING

A. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches (32 mm), wall attachment flange of 7/8 inch (22 mm), minimum bare metal thickness of 0.0179 inch (0.45 mm), and depth required to fit insulation thickness indicated.

2.03 MISCELLANEOUS MATERIALS

A. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide exposed fasteners with heads matching color of metal wall panels by means of plastic caps or factory-applied coating.
   1. Fasteners for Wall Panels: Self-drilling or self-tapping, zinc-plated, hex-head carbon-steel screws, with a stainless-steel cap or zinc-aluminum-alloy head and EPDM or neoprene sealing washer.
   2. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws with hex washer head.
   3. Blind Fasteners: High-strength aluminum or stainless-steel rivets.

B. Joint Splines:
   1. Aluminum/Metal Composite material to match panel, provided by panel Manufacturer.

C. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

D. Welding Standards: As follows:
   1. Comply with AWS AWS D1.2/D1.2M, “Structural Welding Code – Aluminum.”
   2. Comply with AWS AWS D1.3/D1.3M , “Structural Welding Code – Sheet Steel.”

2.04 COMPOSITE METAL WALL PANELS

A. General: Provide factory formed and assembled metal wall panels fabricated from 2 metal facing sheets and core material laminated or otherwise securely bonded, without use of contact adhesives or pinch rollers, to facing sheets during fabrication.
   1. Face Sheets: Aluminum alloy 3105 H14, 0.020 inch (0.51 mm) thick and as follows:
      a. Class I, Color Anodic Finish: AA-M12C22A42/A44.
      b. Thermally bonded in a continuous process, under tension, to the core material.
   2. Core: Thermoplastic material that meets performance characteristics specified when fabricated into composite assembly.
   3. Bond Integrity: Tested for resistance to delamination as follows:
      a. Peel Strength (ASTM D1781): 22.5 in-lb/in (100 N-m/m) minimum.
      b. No degradation in bond performance after 8 hours of submersion in boiling water and after 21 days of immersion in water at 70 degrees F (21 degrees C).
   4. Fire Performance:
      a. Flamespread (NFPA 285): Meets Requirements (in tested assembly).
      b. Flamespread (ASTM E84): 25 maximum (4 and 6 mm).
      c. Smoke Developed (ASTM E84): 450 maximum (4 and 6 mm).
      d. Surface Flammability (Modified ASTM E108): Pass (4 and 6 mm).
      e. V-O Rating (4 mm): Comply with UL 94.
   5. Production Tolerances:
      a. Width: +/- 2 mm.
      b. Length: +/- 4 mm.
      c. Thickness (4 mm Panel): +/- 0.008 inch (0.2 mm).
      d. Thickness (6 mm Panel): +/- 0.012 inch (0.3 mm).
      e. Bow: Maximum 0.5% length or width.
      f. Squareness: Maximum 0.2 inch (5 mm).
      g. Edges of sheets shall be square and trimmed.
   6. Drainage: Provide positive drainage to exterior for moisture entering or condensation occurring with panel system.
   7. Finish:
      a. Anodic Finish, see below.
   8. Accessories:
      a. General: Provide fabricator’s standard accessories, including fasteners, clips, anchorage devices and attachments for specific applications indicated on contract documents.

2.05 MODULAR METAL WALL PANELS

A. General: Provide factory formed and assembled modular, prefinished metal wall panels with hemmed edges.
   1. Basis of Design: ATAS International, Versa-Lok.
   2. Panel Composition:
      a. Aluminum, .040 in thick.
      b. Comply with ASTM B209/B209M.
   3. Finish:
      a. PVDF Finish, see below.
   4. Panel size:
      a. As shown on drawings.

5. Panel installation:
    a. Panels are installed overlapping and with staggered joints.
    b. See drawings and manufacturer's standard details.
6. Accessories:
    a. General: Provide fabricator’s standard accessories, including fasteners, clips, anchorage devices and attachments for specific applications indicated on contract documents.

2.06 ACCESSORIES

A. Wall Panel Accessories: Provide components required for a complete metal wall panel assembly including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal wall panels, unless otherwise indicated.

B. Flashing and Trim: Formed from 0.0179-inch- (0.45-mm-) thick, metallic-coated steel sheet. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal wall panels.

C. Butyl Tape: Type and size as recommended by panel manufacturer.

D. Clip Angles/Channels: 1/8 inch thick formed metal, compatible with plate panel skin.

E. Fasteners: As recommended by panel manufacturer.

F. Soffit Panels:
1. Architectural Building Components; Flush Panel.
2. ATAS International, Inc.; Wind-Lok Soffit Panel.
3. Berridge Manufacturing Co.; FW-12 Panel.
4. Carlisle Metals Company: CM FWI Panel.
5. Approved substitution.

2.07 FABRICATION

A. General: Fabricate and finish metal wall panels and accessories at factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
1. Form panel lines, breaks, and angles to be sharp and true, with surfaces free from warp and buckle.
2. Fabricate wall panels with panel stiffeners as required to maintain fabrication tolerances and to withstand design loads.

B. Fabricate metal wall panels in a manner that eliminates condensation on interior side of panel and with joints between panels designed to form weathertight seals.

C. Composite Metal Wall Panels: Fabricate panels using manufacturer's standard thermosetting structural adhesive in a lamination process that bonds panel under minimum 10-psi (69-kPa) pressure. Use of contact adhesives with pinch-roll process is not acceptable.

D. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA (ASMM) "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

E. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

2.08 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with system established by the Aluminum Association for designating aluminum finishes.

B. Class I, Color Anodic Finish: AA-M12C22A42/A44 (Mechanical finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I integrally colored or

electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 606.1 or AAMA 608.1.
1. Color: Dark Bronze. Match Exterior Storefront Color.

C. Factory applied Polyvinylidene fluoride (PVDF) finish.
1. Dry Film Thickness: ASTM D1005, ASTM D1400, ASTM D4138 or ASTM D5796
2. Abrasion Resistance: ASTM D968
3. Acid Resistance: ASTM D1308
4. Acid Rain Resistance (Kesternich): ASTM G87 or DIN 50018
5. Salt Spray: ASTM B117
6. Color: to be selected by Architect.

PART 3 EXECUTION

3.01 PREPARATION

A. Install flashings and other sheet metal to comply with requirements specified in Section 07 62 00.

B. Miscellaneous Framing: Install subgirts, base angles, sills, furring, and other miscellaneous wall panel support members and anchorage per ASTM C754 and metal wall panel manufacturer's written recommendations.

3.02 METAL WALL PANEL INSTALLATION, GENERAL

A. General: Install metal wall panels in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to girts and subgirts, unless otherwise indicated. Anchor metal wall panels and other components of Work securely in place, with provisions for thermal and structural movement.
1. Field cutting of metal wall panels by torch is not permitted.
2. Rigidly fasten base end of metal wall panels and allow eave end free movement due to thermal expansion and contraction. Predrill panels.
3. Install screw fasteners in predrilled holes.
4. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
5. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete, and elsewhere as indicated or, if not indicated, as necessary for waterproofing.
6. Provide weatherproof escutcheons for pipe and conduit penetrating exterior walls.

B. Fasteners: Use aluminum or stainless-steel fasteners for surfaces exposed to exterior and aluminum or galvanized steel fasteners for surfaces exposed to interior.

C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal wall panel manufacturer.
1. Coat back side of aluminum wall panels with bituminous coating where wall panels will contact wood, ferrous metal, or cementitious construction.

3.03 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal wall panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal wall panel installation, clean finished surfaces as recommended by metal wall panel manufacturer. Maintain in a clean condition during construction.

B. After metal wall panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

C. Clean exposed surfaces of sun control devices that are not protected by temporary covering to remove fingerprints and soil during construction period.

D. Clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.

E. Protect sun control assemblies from damage during construction. Use temporary protective coverings where needed as approved by the sun control manufacturer.

F. Clean and touch up minor abrasions in finished with air-dried coating that matches color and gloss, and is compatible with, factory–applied finish coating.

END OF SECTION

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SECTION 07 46 33
PHENOLIC WALL SIDING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Exterior solid phenolic cladding: factory fabricated panel system and accessories as required for a complete drained and back-ventilated rainscreen system.
   1. Wall panels.
   2. Fascia.
   3. Horizontal soffits.
   4. Storefront panels.

B. Interior solid phenolic cladding: factory fabricated panel system and accessories as required for a complete drained and back-ventilated rainscreen system.
   1. Wall panels.
   2. Horizontal soffits and trim around door and window openings.

1.02 RELATED SECTIONS

A. Section 01 33 00 - Submittal Procedures.

B. Section 01 40 00 - Quality Requirements.

C. Section 01 60 00 - Product Requirements.

D. Section 04 20 00 - Unit Masonry

E. Section 07 54 23 - Thermoplastic Polyolefin (TPO) Roofing.

F. Section 07 62 00 - Sheet Metal Flashing and Trim.

G. Section 09 21 16 - Gypsum Board Assemblies.

H. Section 10 14 00 - Signage.

1.03 REFERENCE STANDARDS

A. ASTM International (ASTM):
   1. ASTM B 117 – Standard Practice for Operating Salt Spray (Fog) Apparatus.
   2. ASTM D 635 – Standard Test Method for Small Scale Burning.
   3. ASTM D 1929 – Standard Test Method for Ignition Temperature.
   4. ASTM D 2244 – Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates.
   5. ASTM D 2247 – Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity.
   6. ASTM E 84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
   7. ASTM E 119 – Standard Test Method for Fire Rated or Fire Resistive Construction.
   8. ASTM E 330 – Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors Under the Influence of Wind Loads.

B. European Standards (EN):
   1. EN 438-2 – Decorative High Pressure Laminate (HPL) Sheets Based on Thermosetting Resins - Determination of Properties.
   2. EN 12524 – Building Materials and Products, Hygrothermal Properties, Tabulated Design Values.

C. International Organization for Standardization (ISO):
   1. ISO 105 A02-93 – Tests for Color Fastness – Part A02: Grey scale for assessing change in color.
   2. ISO 178 – Determination of Flexural Properties.
   3. ISO 527-2 – Determination of Tensile Properties.
   4. ISO 846 – Evaluation of the Action of Organisms.

5. ISO 1183 – Determination of Density of Non Cellular Plastics.
6. ISO 13894-1 – High Pressure Decorative Laminates.

1.04 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00.

1.05 SUBMITTALS

A. Submit under provisions of Section 01 30 00.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Material Property Datasheet.
   2. Storage and handling requirements and recommendations.
   3. Installation Manual.

C. Drawings: Submit plan, section, elevation and perspective drawings necessary to describe and convey the layout, profiles and product components, including edge conditions, panel joints, fixture location, anchorage, accessories, finish colors.

D. Code Compliance: Documents showing product compliance with local building code shall be submitted prior to the bid. These documents shall include, but not be limited to, appropriate Evaluation Reports and/or test reports supporting the use of the product. Alternate materials must be approved by the architect of record prior to the bid date.

E. Selection Samples: For each finish product specified, submit color chips representing manufacturer's full range of available colors and patterns.

F. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.
   3. See Sections 01 33 00 and 01 60 00.

G. Operation and Maintenance Data: Submit O&M manuals according to the requirements of Section 01 92 00 - Facility Operation and Maintenance.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Delivery:
   1. During transportation, use stable, flat pallets that are at least the same dimension as the material.
   2. Materials are packaged to minimize or eliminate the possibility of damage during shipping. Items such as wooden side boards, wooden lid, and spacers or protective sheeting between panels shall be used to protect the panels from surface and/or edge damage.

B. Storage:
   1. Store products in an enclosed area protected from direct sunlight, moisture and heat. Maintain a consistent temperature and humidity.
   2. Store products in manufacturer's unopened packaging until ready for installation.
   3. Stack panels using protective dividers to avoid damage to decorative surface.
   4. For horizontal storage, store on pallets of equal or greater size as the panels with a protective layer between the pallet and panel.
   5. Do not store fabricated panels vertically.

C. Handling:
   1. Remove protective film within 24 hours of the panels being removed from the pallet.
   2. When moving panels, lift evenly to avoid dragging panels across each other and scratching the decorative surface.
   3. Remove all labels and stickers immediately after installation.

1.07 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

B. Field Measurements: Verify actual measurements/openings by field measurements performed by the installer. Recorded measurements to be indicated on drawings based on field measurements provided by the installer.

1.08 WARRANTY

A. Warranty: At project closeout, provide manufacturer's limited ten year warranty covering defects in materials.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Exterior Phenolic Panels **[PHP-1]**: Acceptable Manufacturer: Trespa International B.V.; P.O. Box 110, 6000 AC Weert Wetering 20, 6002 SM Weert The Netherlands; www.trespa.com.
   1. Acceptable Manufacturer's Representative: Trespa North America, Ltd.; 62 Greene St (Ground Floor) New York, New York 10012. ASD. Toll Free Tel: (800) 4-TRESPA. Fax: (866) 298-3499. Email: info.northamerica@trespa.com. Web: http://www.trespa.com/na.
   2. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00.

B. Interior Phenolic Panels **[PHP-2]**: Acceptable Manufacturer: Abet Laminati. https://abetlaminati.com/en.
   1. Vendor: Tegan Marketing. Contact Paul Tegan. Phone 763-475-1340. Email: paul@teganmarketing.com.
   2. Substitutions: Not permitted.

2.02 WALL SIDING SYSTEM

A. **[PHP-1]** Solid Phenolic Wall Panels: Trespa® PuraNFC® by Trespa International as represented by Trespa North America, LTD. http://live.trespa.com/
   1. Material: Solid panel manufactured using a combination of high pressure and temperature to create a flat panel created from thermosetting resins, homogenously reinforced with wood-based fibers and an integrated decorative surface or printed décor.
   2. Siding System: Trespa® PuraNFC® is a factory fabricated High Pressure Laminate material used in conjunction with siding accessories and components to provide a cladding for a drained and back ventilated rainscreen wall system.
   3. Color: PU24 Mystic Cedar
   4. Finish: Matte sheen.
   5. Flush Siding System.
   6. Panel Core: Fire retardant (FR) core.
   7. Panel Thickness: 5/16 inch (8 mm).
   8. Physical Properties:
      a. Modulus of Elasticity: 1,300,000 psi (9000 N/mm2) minimum, ISO 178.
      b. Tensile Strength: 10,100 psi (70 N/mm2) minimum, ISO 527-2.
      c. Flexural Strength: 14,500psi (120 N/mm2) minimum, ISO 178.
   9. Fire Performance:
      a. Flame Spread: Class A, ASTM E84.
      b. Smoke Development: Less than 450, ASTM E84.
   10. Finish Performance: Electron Beam Cure resin in conformance with the following general requirements:
      a. Color: As selected by the architect/engineer from manufacturer's standard colors.
      b. Resistance to Climactic Shock: EN 438-2:19.
      c. Resistance to Artificial Weathering: EN 438-2:29.

d. Color Stability: The decorative surface comply with, classification, 4 - 5 measured with the grey scale according to ISO 105 A02-93 according to test method EN 438-2:29.
e. Resistance to SO2: DIN 50018.
f. Microbial Characteristics: Will not support micro-organic growth (ISO 846).

11. Mounting System:
    a. Flush Siding System.
    b. Other installation systems – Include test documentation showing compliance with the performance criteria set forth in the specification and in accordance with the local building code.
12. Sub Structure:
    a. Sub-structure designed to withstand structural loading due to wind load and the dead load of the panel, painted as required to conceal behind the open joinery of the attachment system.
    b. Extrusions, battens, including corner closures, joint closures and vent screens, formed members, sheet, and plate shall conform with the recommendations of the manufacturer.
13. Fasteners: All fasteners to be concealed, no exceptions. Fasteners are non-corrosive. Fastener color to be black.
14. Accessories:
    a. Extruded aluminum trim includes outside corners, inside corners, start profiles, j channel, and finish profiles.
    b. All Trim pieces color to be Black.

B. **[PHP-2]** Phenolic Exterior Wall Cladding: Solid phenolic laminate panel with UV protective clear coat.
1. Style: EASY MEG Closed Joint.
2. Color: Walnut: Match Architect's sample.
3. Install Pattern: See drawings.
4. Finish: Matte.
5. Size: 7 5/8" x 96"
6. Thickness: 5/16"
7. Panel Core: Phenolic resin treated layer, black and natural brown kraft paper.
8. Decorative Layer: Melamine resin, proprietary pigmented and treated.
9. Weather and UV Resistant Layer: 2-mil, proprietary layer combining pigment protection, Ultraviolet light and weather resistant layer.
10. Physical Properties:
    a. Flexural Strength, ASTM D790.
        1) Machine Direction: 19,000 psi.
        2) Cross Direction: 16,000 psi.
    b. Flexural Modulus, ASTM D790.
        1) Machine Direction: 1,300,000 psi.
        2) Cross Direction: 1,000,000 psi.
    c. Tensile Modulus, ASTM D638.
        1) Machine Direction: 14,000 psi.
        2) Cross Direction: 10,000 psi.
    d. Structural Performance: Withstand design wind load based on building code, but not less than 23 psf with maximum L/180 tested to ASTM E330.
    e. Fire Performance:
        1) Flame Spread/Smoke Developed: Class A tested to ASTM E84.
        2) Ignition Temperature: Greater than 650 degrees F (350 degrees C) above ambient, tested to ASTM D1929.
        3) Extended Surface Burn: Max Flame Front less than 10 feet, tested to ASTM E2768.
        4) When required for compliance with local building codes, wall assembly shall meet the performance requirements of NFPA 285.

5) When required for compliance with local building codes, wall assemblies shall not ignite when exposed to a radiant heat energy source, NFPA 268.

f. Finish Performance:

1) Humidity Resistance: No cracking, checking, crazing, erosion, delamination, distress, tested to ASTM D2247.

2) Salt Spray Resistance: No cracking, checking, crazing, Erosion, Delamination, or distress, tested to ASTM B117.

3) Weather Exposure: Maximum gray scale change of 3-4 according to DIN EN 438-2 29 when tested to ASTM D2244 at accelerated – 3000 Hours in Atlas Type Weatherometer using cycle of 102 minutes light and 18 minutes diminished light and demineralized water.

11. Mounting System:
    a. Close Joint Clip.
12. Accessories:
    a. Horizontal, perforated rails, edge closures, shims and sealant by manufacturer.
    b. Concealed Fasteners.
    c. All exposed elements to be finished Black.

2.03 FABRICATION

A. Panels: Solid phenolic impregnated kraft paper wall panels with no voids, air spaces or foamed insulation in the core material. Accessory items in accordance with manufacturer's recommendations and approved submittals. Panel edges are factory fabricated to be used with the provided hardware system.

B. Panel Dimensions: Field fabrication shall be allowed where necessary, but shall be kept to an absolute minimum.

C. Appearance: Panel lines, breaks, and angles shall be sharp, true, and surfaces free from warp and buckle.

D. Fabrication Tolerances: Manufacturer to provide shop fabrication and pre-finishing for a warranted finish.
1. NEMA Testing Results:
    a. Dimensional Change, 3.11 test.
    b. Length (Machine Direction): 0.25 percent.
    c. Width (Cross Direction): 0.50 percent.
2. Weight Per Unit Area:
    a. Pounds/ square feet: 2.4-2.7
    b. Density: 86 pounds per cubic foot.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. Surfaces to receive panels shall be even, smooth, dry, and free from defects detrimental to the installation of the panel system.
1. Notify Contractor in writing of conditions detrimental to proper and timely completion of the work.

C. Confirm substrate is plumb and level, with no deflection greater than 1/4 inch (6 mm) in 20 feet (6096 mm).

D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
1. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

A. Install solid phenolic wall panels and sub-frame system in accordance with manufacturer's instructions.

B. Install solid phenolic wall panels plumb and level and accurately spaced in accordance with manufacturer's recommendations and approved submittals and drawings.

C. Anchor panels and sub-framing securely per engineering recommendations and in accordance with approved shop drawings to allow for necessary movement and structural support.

D. Fasten solid phenolic wall panels with fasteners approved for use with supporting substrate.

E. Do not install panels or component parts which are observed to be defective or damaged including, but not limited to: warped, bowed, abraded, scratched, and broken members.
   1. Damaged components are to be replaced at no cost to Owner.

F. Do not cut or trim component parts during installation in a manner that would damage the finish, decrease the strength, or result in visual imperfection or a failure in performance. Return component parts with require alteration to the shop for re-fabrication or replacement.

G. Install corner profiles and trim with fasteners appropriate for use with adjoining construction as indicated on the Contract Drawings and as recommended by manufacturer.

3.04 ADJUSTING AND CLEANING

A. Remove masking or panel protection as soon as possible after installation. Any masking intentionally left in place after panel installation on an elevation, shall become the responsibility of the General Contractor to remove.

B. Adjust final panel installation so that all joints are true and even throughout the installation. Panels out of plane shall be adjusted with the surrounding panels to minimize any imperfection.

C. Repair panels with minor damage. Remove and replace panels damaged beyond repair as a direct result of the panel installation.
   1. After installation, panel repair and replacement shall become the responsibility of the General Contractor.

D. Clean finished surfaces as recommended by panel manufacturer. After installation cleaning, cleaning during construction shall become the responsibility of the General Contractor.

END OF SECTION

SECTION 07 54 23
THERMOPLASTIC POLYOLEFIN (TPO) ROOFING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Vapor barrier.
   2. Roof insulation.
   3. Substrate for roofing.
   4. Fully adhered thermoplastic polyolefin (TPO) roofing system.
   5. Flexible flashings.
   6. Accessory sealants.
   7. Roof walkway system.

1.02 RELATED SECTIONS

A. Section 01 33 00 - Submittal Procedures.

B. Section 01 40 00 - Quality Requirements.

C. Section 01 60 00 - Product Requirements.

D. Section 03 30 00 - Cast in Place Concrete.

E. Section 05 31 00 - Steel Decking.

F. Section 06 10 00 - Rough Carpentry.

G. Section 07 08 00 - Commissioning of Thermal and Moisture Protection.

H. Section 07 21 00 - Thermal Insulation.

I. Section 07 62 00 - Sheet Metal Flashing and Trim.

J. Section 07 72 33 - Roof Hatches.

K. Section 07 92 00 - Joint Sealants.

1.03 REFERENCES

A. ANSI/SPRI/FM 4435/ES-1 - Test Standard for Edge Systems Used with Low Slope Roofing Systems; 2022.

B. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

C. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2023a.

D. ASTM D6878/D6878M - Standard Specification for Thermoplastic Polyolefin-Based Sheet Roofing; 2021.

E. ASTM E108 - Standard Test Methods for Fire Tests of Roof Coverings; 2020a.

F. FM 4450 - Class 1 Insulated Steel Deck Roofs; Current Edition.

G. FM 4470 - Examination Standard for Single-Ply, Polymer-Modified Bitumen Sheet, Built-Up Roof (BUR) and Liquid Applied Roof Assemblies for Use in Class 1 and Noncombustible Roof Deck Construction; 2022.

H. FM 1-28 - Design Wind Loads; Factory Mutual System; 2007.

I. FM 1-29 - Roof Deck Securement and Above Deck Roof Components; Factory Mutual System; 2006.

J. ICC (IECC)-2021 International Energy Conservation Code, 2021 or most recent adopted edition.

K. SPRI ES-1 - Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems; 2007. (ANSI/SPRI ES-1).

1.04 SYSTEM DESCRIPTION

A. Design: Drawings are based on generic, single ply membrane roofing system.
   1. System to be fully adhered upon a composite roof deck.
   2. Selected roofing system manufacturer and installer shall provide all necessary details to ensure roofing system meets specified regulatory and performance requirements, over building structure indicated.

1.05 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other Work.
   1. Base flashings and membrane terminations.
   2. Tapered insulation, including slopes.
   3. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.

C. Meeting Submittals:
   1. Pre-installation meeting minutes.

D. Materials and Equipment Submittals:
   1. Shop Drawings:
      a. Prepared by roofing membrane manufacturer, indicating roof configuration, sheet layout, perimeter details and all joint details or termination conditions and conditions of interface with other materials. Assign Shop Drawings a project number or name referencing this specific project.
      b. Pre-Warranty Submittal: Submit “Sample” warranty from membrane manufacturer. Sample warranty shall include manufacturer’s warranty number, duration of warranty, name of project, address of project, and shall identify the roofing contractor and describe the roofing materials and assembly to be installed by this roofing contractor.
   2. Product Data and Installation Instructions: Indicating sheet membrane, elastic flashing, joint cover sheet, and joint and crack sealants, with temperature range for application of membrane.

E. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.
   3. See Sections 01 33 00 and 01 60 00.

F. Quality Control Submittals: Submit the following:
   1. Certification: Indicating that applicator has been factory trained and approved by membrane manufacturer to install roofing membrane.
   2. Certification: Indicating compliance with specified regulatory requirements.
      a. Submit test reports, listing cards, or other documentation showing compliance.
      b. Include wind uplift resistance in roofing system submittals. Indicate compliance with uplift performance requirements.
   3. Inspection Report: Indicating approval by membrane manufacturer's inspector.

G. Closeout Submittals:
   1. Warranty: As specified in this Section.

1.06 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Manufacturer Qualifications: Qualified manufacturer that is approved by FM Approvals for membrane roofing system identical to that used for this Project.

C. Installer Qualifications: Qualified firm, with a minimum of 5 years experience specializing in the installation of specified roofing system, which is approved, authorized, or licensed by membrane

roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1. Installer shall be experienced in seam probe and patch activity. Include in Bid Costs to execute a complete probe of welds on roofing system and to make repairs to seam defects.
2. Maintain full-time field superintendent or foreman, with minimum of 5 years experience in all phases of installation with specified roofing system, at Project site during roofing installation.

D. Source Limitations: Obtain components, including roof insulation and fasteners, if any, for membrane roofing system from same manufacturer as membrane roofing or approved by membrane roofing manufacturer.

E. Exterior Fire-Test Exposure: ASTM E108, Class A; for application and roof slopes indicated, as determined by testing identical membrane roofing materials by qualified testing agency. Identify materials with appropriate markings of applicable testing agency.

F. Pre-Installation Meeting: Convene pre-installation meeting a minimum of 1 week prior to commencing Work of this Section.
   1. Require attendance of LTF Construction Project Manager or Superintendent, Roofing System Applicator, Technical Representative employed by Roofing System Manufacturer and other parties directly affecting Work of this Section.
   2. Meeting Notes: Roofing Contractor shall maintain minutes of meeting and shall distribute within 3 working days of the meeting to the following LTF Construction.
   3. Pre-Installation Meeting Agenda:
      a. Review of drawings and specifications for application of roofing system.
      b. Review of applicable local code requirements for roofing system.
      c. Review proposed application procedures and coordination required with other trades.
      d. Presentation of a booklet of the standard technical details from the manufacturer's Technical Manual that shall be utilized for the installation.
      e. Deviations from the Technical Manual, (i.e. approved project details, either from project Drawings or proposed by roofing contractor), that have also been approved by LTF Construction.
      f. Review of permitting process and local code requirements, where applicable.
      g. Review of Project Conditions:
         1) Tentative timetable of execution.
         2) Work Crew: expectations for the execution of the project within the timetable.
         3) Roofing contractor's superintendent: Identify individual who shall be present during the duration of the installation.
         4) Emergency Contact and 24 hour Response Number.
         5) Review of Forecasted Weather Conditions:
            (a) Roofing contractor's practice for securing and storage of product on the roof which shall prevent damage or loss of product during high winds or precipitation.
      h. Review the following with the roofing contractor:
         1) Commitment to a timely execution.
         2) Summary statement of roof quality control practices:
            (a) Routine seam sampling.
            (b) Complete and systematic probe and patch of all seam defects.
         3) Roofing contractor to identify rooftop conditions and locations where other trades are notified against abuse of roof membrane from:
            (a) Contaminants.
            (b) Smoking.
            (c) Construction debris.
         4) Review proposed changes and deviations from drawings and specifications.
      i. Review of shop drawings for perimeter edge, tie in of lower roofs to vertical walls (where specified) and other required submittals.

j. Review required inspections, contractor licensing by manufacturer, contractor history managing and executing projects of this size, and quality expectations for this application.
k. Review definition of what is an “approved deck” which shall be covered with roofing system.
l. Review perimeter wall cap elevations and lumber attachment as a suitable substrate for receiving the waterproofing perimeter flashings.
m. Review submission of Pre-Warranty Submittal as specified herein.
1) Pre-Application Inspection:
(a) Walk-through of area to receive roofing application.
(b) Agreement on condition of decking and walls as acceptable for receiving new roofing system.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

E. Roofing Contractor shall store roofing materials according to Manufacturer’s Requirements.

1.08 FIELD CONDITIONS

A. Ambient Conditions: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed per manufacturer's written instructions and warranty requirements.

B. Ensure roof is temporarily protected from water infiltration at end of each work day. Do not install for water tight condition during construction phase.

1.09 WARRANTY

A. Special Warranty: Manufacturer's Total System Warranty, without monetary limitation, in which manufacturer agrees to repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period.
1. Special warranty includes membrane roofing, base flashings, roof insulation, fasteners, roofing accessories, and other components of a complete membrane roofing system.
a. Include warranted wind speed rating with documentation.
2. Warranty Period: 20 years from date of Substantial Completion.
3. Certification is required with bid submittal indicating the manufacturer has reviewed and agreed to such wind coverage.
4. Pro-rated system warranties will not be accepted.
5. As a special consideration for Owner – Manufacturer shall provide an inspection at 24 months post warranty start date. Inspection request shall be initiated by Owner.

B. Include evidence of manufacturer's warranty reserve as part of Project submittals for Architect's approval.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. General Performance: Installed membrane roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective

manufacture, fabrication, installation, or other defects in construction. Membrane roofing and base flashings shall remain watertight.

B. Structural loads by the Engineer of Record are as indicated in the Structural documents.

C. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by membrane roofing manufacturer based on testing and field experience.

D. Roofing System Design: Provide membrane roofing system that is identical to systems that have been successfully tested by qualified testing and inspecting agency to resist uplift pressure calculated per ASCE 7.
   1. Structural loads shall be provided by the Engineer of Record.

E. FM Approvals Listing: Provide membrane roofing, base flashings, and component materials that comply with the following requirements:
   1. FM 4450 and FM 4470 as part of a membrane roofing system, and that are listed in FM Approvals' "RoofNav" for Class 1 or noncombustible construction, as applicable.
   2. ANSI/SPRI/FM 4435/ES-1 as part of edge performance for membrane roofing system in resistance to wind uplift.
   3. Fire/Windstorm Classification: Class 1A-90. To be verified prior to bidding.
   4. Identify materials with FM Approvals markings.

F. Warranty: Insulation supplied by membrane manufacturer to be included with roof warranty.

2.02 TPO MEMBRANE ROOFING

A. **(NOT USED)**: Mechanically Fastened Thermoplastic Polyolefin Sheet: ASTM D6878/D6878M, internally fabric or scrim reinforced, uniform, flexible TPO sheet.
   1. Basis of design: Amrize Building Envelope: Elevate UltraPly TPO, InvisiWeld System.
   2. Mechanically attached via induction welding process at steel deck roofs. See Drawings.
   3. Thickness: 60 mils (1.5 mm), nominal.
   4. Color:
      a. TPO-1: Exposed Face Color: White. (Typical)
   5. Other Acceptable Manufacturers:
      a. Carlisle SynTec Incorporated.
      b. Flex Roofing Systems.
      c. GAF Materials Corporation.
      d. Johns Manville.
      e. Mule-Hide Products Co., Inc.
      f. Versico Incorporated.

B. Fully Adhered Thermoplastic Polyolefin Sheet: ASTM D6878/D6878M, externally reinforced, uniform, flexible TPO sheet.
   1. Basis of design: Amrize Building Envelope: Elevate: Ultraply Flex SA
   2. Fully adhered at concrete or composite roof decks. See Drawings.
   3. Thickness: 60 mils (1.5 mm), nominal.
   4. Color:
      a. TPO-1: Exposed Face Color: White. (Typical)
   5. Other Acceptable Manufacturers:
      a. Carlisle SynTec Incorporated.
      b. Flex Roofing Systems.
      c. GAF Materials Corporation.
      d. Johns Manville.
      e. Mule-Hide Products Co., Inc.
      f. Versico Incorporated.

2.03 AUXILIARY MEMBRANE ROOFING MATERIALS

A. General: Auxiliary membrane roofing materials recommended by roofing system manufacturer for intended use, and compatible with membrane roofing.
   1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.

B. Membrane Adhesive: Manufacturer's recommended spray adhesive.
   1. Elevate Building Products: Jet Bond Spray Adhesive
   2. Or approved Equal.

C. Sheet Flashing: Manufacturer's standard unreinforced thermoplastic polyolefin sheet flashing, 55 mils (1.4 mm) thick, minimum, of same color as sheet membrane.

D. Bonding Adhesive: Manufacturer's standard.

E. Slip Sheet: Manufacturer's standard, of thickness required for application, when required by roof system manufacturer.

F. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 inch by 1/8 inch (25 by 3 mm) thick; with anchors.

G. Metal Battens: Manufacturer's standard, aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately 1 inch wide by 0.05 inch thick (25 mm wide by 1.3 mm thick), prepunched.

H. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM 4470, designed for fastening membrane to substrate, and acceptable to membrane roofing system manufacturer and designer of substrate.

I. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, cover boards, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

2.04 ROOF INSULATION

A. General: Preformed roof insulation boards manufactured or approved by TPO membrane roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated.

B. Roof Insulation: Where indicated, provide the following types of insulation:
   1. Main Roof Field: Polyisocyanurate board insulation, ASTM C1289, felt or glass-fiber mat facer on both major surfaces. Insulation shall be provided in two layers, maximum board thickness of 2.6" inches.
      a. Manufacturers and product: Ox Engineered Products: Ox ISO Red Max Polyisocyanurate.
         1) Or approved equal.
      b. Edges: Square.
      c. Type II, Class I, Grade 2.
      d. Total System R Value: 30 min.
   2. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches (1:48) unless otherwise indicated.

C. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

2.05 INSULATION ACCESSORIES

A. General: Furnish roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with membrane roofing.
   1. Cover Board: High density Insulating cover board by Manufacturer.
   2. Insulation fasteners: Specially engineered and manufactured for the induction welding process. Type and size by roofing manufacturer.

B. Applied Insulation Adhesive: Insulation manufacturer's recommended low-rise, 2-component polyurethane adhesive formulated to attach roof insulation to substrate or to another insulation layer.
   1. Elevate Building Product: ISO Twin Pack Adhesive.
   2. Or approved equal.

2.06 WALKWAYS

A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads, approximately 3/16 inch (5 mm) thick, and acceptable to membrane roofing system manufacturer.

2.07 VAPOR BARRIER

A. Provide a Class I vapor barrier as recognized by the International Building Code. Prepare substrate and install per manufacturer's published specification.
   1. Provide vapor barrier equivalent to Holcim Elevate: V-Force Vapor Barrier Membrane.

PART 3 EXECUTION

3.01 GENERAL

A. Install roofing, insulation, flashings, and accessories in accordance with roofing manufacturer's published instructions and recommendations for the specified roofing system. Where manufacturer provides no instructions or recommendations, follow good roofing practices and industry standards. Comply with federal, state, and local regulations.

B. Obtain all relevant instructions and maintain copies at project site for duration of installation period.

C. Do not start work until Pre-Installation Notice has been submitted to manufacturer as notification that this project requires a manufacturer's warranty.

D. Perform work using competent and properly equipped personnel.

E. Temporary closures, which ensure that moisture does not damage any completed section of the new roofing system, are the responsibility of the applicator. Completion of flashings, terminations, and temporary closures shall be completed as required to provide a watertight condition.

F. Install roofing membrane only when surfaces are clean, dry, smooth and free of snow or ice; do not apply roofing membrane during inclement weather or when ambient conditions will not allow proper application; consult manufacturer for recommended procedures during cold weather. Do not work with sealants and adhesives when material temperature is outside the range of 60 to 80 degrees F (15 to 25 degrees C).

G. Protect adjacent construction, property, vehicles, and persons from damage related to roofing work; repair or restore damage caused by roofing work.
   1. Protect from spills and overspray from bitumen, adhesives, sealants and coatings.
   2. Particularly protect metal, glass, plastic, and painted surfaces from bitumen, adhesives, and sealants within the range of wind-borne overspray.
   3. Protect finished areas of the roofing system from roofing related work traffic and traffic by other trades.

H. Until ready for use, keep materials in their original containers as labeled by the manufacturer.

I. Consult membrane manufacturer's instructions, container labels, and Material Safety Data Sheets (MSDS) for specific safety instructions. Keep all adhesives, sealants, primers and cleaning materials away from all sources of ignition.

J. Until ready for use, keep materials in their original containers as labeled by the manufacturer.

K. Consult membrane manufacturer's instructions, container labels, and Material Safety Data Sheets (MSDS) for specific safety instructions. Keep all adhesives, sealants, primers and cleaning materials away from all sources of ignition.

3.02 EXAMINATION

A. Examine roof deck to determine that it is sufficiently rigid to support installers and their mechanical equipment and that deflection will not strain or rupture roof components or deform deck.

B. Verify that surfaces and site conditions are ready to receive work. Correct defects in the substrate before commencing with roofing work.

C. Verify that the specifications and drawing details are workable and not in conflict with the roofing manufacturer's recommendations and instructions; start of work constitutes acceptable of project conditions and requirements.

3.03 PREPARATION

A. Take appropriate measures to ensure that fumes from adhesive solvents are not drawn into the building through air intakes.

B. Prior to proceeding, prepare roof surface so that it is clean, dry, and smooth, and free of sharp edges, fins, roughened surfaces, loose or foreign materials, oil, grease and other materials that may damage the membrane.

C. Fill all surface voids in the immediate substrate that are greater than 1/4 inch (6 mm) wide with fill material acceptable to membrane manufacturer.

D. Seal, grout, or tape deck joints, where needed, to prevent material seepage into building.

3.04 VAPOR BARRIER INSTALLATION

A. All deck/deck cover substrates (except metal decks) must be primed prior to application. Use only primer supplied by membrane manufacturer.

B. Application can be made at ambient temperatures as low as 25 °F (-4 °C) as long as membrane has been stored in a heated area so that it will be between 50 °F (10 °C) and 100 °F (38 °C) at the time of application.

C. Install insulation in a manner that will not compromise the vapor retarder integrity.

D. Install with minimum 3" (76.2 mm) side laps and 6" (152.4 mm) end laps.

E. Roll in with a 75 lb (34 kg) roller to fully mate each roll to substrate, including all lap areas.

3.05 INSULATION INSTALLATION

A. Install insulation in configuration and with attachment method(s) specified in PART 2, under Roofing System.

B. Install only as much insulation as can be covered with the completed roofing system before the end of the day's work or before the onset of inclement weather.

C. Lay roof insulation in courses parallel to roof edges.

D. Neatly and tightly fit insulation to all penetrations, projections, and nailers, with gaps not greater than 1/4 inch (6 mm). Fill gaps greater than 1/4 inch (6 mm) with acceptable insulation. Do not leave the roofing membrane unsupported over a space greater than 1/4 inch (6 mm).

E. Mechanical Fastening: Using specified fasteners and TPO coated insulation plates engage fasteners through insulation into deck to depth and in pattern required by Factory Mutual for FM Class specified in PART 2 and membrane manufacturer, whichever is more stringent.

F. Stagger insulation joints at each layer and between panels.
   1. Follow Manufacturers instructions for panel overlap.

3.06 SINGLE-PLY MEMBRANE INSTALLATION

A. Install only as much insulation as can be covered with the completed roofing system before the end of the day's work or before the onset of inclement weather.

B. Lay out the membrane pieces so that field and flashing splices are installed to shed water.

C. Install membrane without wrinkles and without gaps or fishmouths in seams; bond and test seams and laps in accordance with membrane manufacturer's instructions and details.

D. Install membrane mechanically attached to the substrate using fasteners and edge securement as specified and as required by membrane manufacturers.

E. Induction welding equipment shall be provided by others but approved for use by Manufacturer. All roofing contractors intending to use the equipment shall have successfully completed a training course provided by Manufacturer prior to installation.

1. Induction welding tool calibration: As per the tool manufacturer’s printed guidelines, perform a tool calibration with induction welding tool, making test samples in the field with the TPO membrane and InvisiWeld plate. Before welding the membrane to the plates, calibrate the energy setting of the induction device following manufacturer’s instructions. Perform a peel test, at different energy settings and set the device at the lowest energy setting that creates a 100% bond.

F. All membrane to be welded shall be clean and dry.

G. Induction welding of the membrane: Follow induction tool manufacturer’s printed guidelines. Activate the weld between the TPO membrane and InvisiWeld plate using the electromagnetic induction device as supplied by others. The induction coil, demarked by a red circle on the device, shall be positioned over the center of the InvisiWeld plate, ± 1 inch (25 mm). Cycle time will be affected by available power, use a heavy gauge power cord, at a minimum 12 gauge by 100 feet.

H. When the induction welding cycle is complete, immediately place a weighted magnetic cooling clamp over the welded TPO membrane & plate assembly. This will ensure that there is adequate clamping of the membrane to the plate during cooling, ensuring a good weld. The magnetic cooling clamp device shall be left in place for a period of 60 seconds, at minimum, while the weld cools and sets.

I. Repeat steps G and H for every plate in assembly.

J. Edge Securement: Secure membrane at all locations where membrane terminates or goes through an angle change greater than 2 in:12 inches (1:6) using mechanically fastened reinforced perimeter fastening strips, HD plates, or metal edging as indicated or as recommended by roofing manufacturer. Do not use InvisiWeld plates for edge securement.
   1. Exceptions: Round pipe penetrations less than 18 inches (460 mm) in diameter and square penetrations less than 4 inches (200 mm) square.
   2. Metal edging is not merely decorative; ensure anchorage of membrane as intended by roofing manufacturer.

3.07 FLASHING AND ACCESSORIES INSTALLATION

A. Install flashings, including laps, splices, joints, bonding, adhesion, and attachment, as required by membrane manufacturer's recommendations and details.

B. Metal Accessories: Install metal edgings, gravel stops, and copings in locations indicated on the drawings, with horizontal leg of edge member over membrane and flashing over metal onto membrane.
   1. Follow roofing manufacturer's instructions.
   2. Remove protective plastic surface film immediately before installation.
   3. Install water block sealant under the membrane anchorage leg.
   4. Flash with manufacturer's recommended flashing sheet unless otherwise indicated.
   5. Where single application of flashing will not completely cover the metal flange, install additional piece of flashing to cover the metal edge.
   6. If the roof edge includes a gravel stop and sealant is not applied between the laps in the metal edging, install an additional piece of self-adhesive flashing membrane over the metal lap to the top of the gravel stop; apply seam edge treatment at the intersections of the two flashing sections.
   7. When the roof slope is greater than 1:12, apply seam edge treatment along the back edge of the flashing.

C. Scuppers: Set in sealant and secure to structure; flash as recommended by manufacturer.

D. Roofing Expansion Joints: Install as shown on drawings and as recommended by roofing manufacturer.

E. Flashing at Walls, Curbs, and Other Vertical and Sloped Surfaces: Install weathertight flashing at all walls, curbs, parapets, curbs, skylights, and other vertical and sloped surfaces that the roofing membrane abuts to; extend flashing at least 8 inches (200 mm) high above membrane surface.
   1. Use the longest practical flashing pieces.

2. Evaluate the substrate and overlay and adjust installation procedure in accordance with membrane manufacturer's recommendations.
3. Complete the splice between flashing and the main roof sheet with specified splice adhesive before adhering flashing to the vertical surface.
4. Provide termination directly to the vertical substrate as shown on roof drawings.

F. Roof Drains:
1. Taper insulation around drain to provide smooth transition from roof surface to drain. Use specified pre-manufactured tapered insulation with facer or suitable bonding surface to achieve slope; slope not to exceed manufacturer's recommendations.
2. Position membrane, then cut a hole for roof drain to allow 1/2 to 3/4 inch (12 to 19 mm) of membrane to extend inside clamping ring past drain bolts.
3. Make round holes in membrane to align with clamping bolts; do not cut membrane back to bolt holes.
4. Apply sealant on top of drain bowl where clamping ring seats below the membrane.
5. Install roof drain clamping ring and clamping bolts; tighten clamping bolts to achieve constant compression.

G. Flashing at Penetrations: Flash all penetrations passing through the membrane; make flashing seals directly to the penetration.
1. Pipes, Round Supports, and Similar Items: Flash with specified pre-molded pipe flashings wherever practical; otherwise use specified self-curing elastomeric flashing.
2. Pipe Clusters and Unusual Shaped Penetrations: Provide penetration pocket at least 2 inches (50 mm) deep, with at least 1 inch (25 mm) clearance from penetration, sloped to shed water.
3. Structural Steel Tubing: If corner radii are greater than 1/4 inch (6 mm) and longest side of tube does not exceed 12 inches (305 mm), flash as for pipes; otherwise, provide a standard curb with flashing.
4. Flexible and Moving Penetrations: Provide weathertight gooseneck set in sealant and secured to deck, flashed as recommended by manufacturer.

3.08 FINISHING AND WALKWAY INSTALLATION

A. Install walkways at access points to the roof, around rooftop equipment that may require maintenance, and where indicated on the drawings.

B. Walkway Pads: Adhere to the roofing membrane, spacing each pad at minimum of 1.0 inch (25 mm) and maximum of 3.0 inches (75 mm) from each other to allow for drainage.
1. If installation of walkway pads over field fabricated splices or within 6 inches (150 mm) of a splice edge cannot be avoided, adhere another layer of flashing over the splice and extending beyond the walkway pad a minimum of 6 inches (150 mm) on either side.
2. Prime the membrane, remove the release paper on the pad, press in place, and walk on pad to ensure proper adhesion.

3.09 FIELD QUALITY CONTROL

A. Roof shall be inspected by inspector under the direct employment of the membrane manufacturer.

B. Seam Inspection:
1. Roof shall be inspected upon completion, or more often as requested by LTF Construction, by inspector under the direct employment of the roof membrane manufacturer.

C. Daily inspections re required to be performed by the roofing applicator.
1. Inspect welded seams after cooling or curing for continuity and integrity, using rounded, blunt end tool suitable for testing membrane which shall not damage roofing.
2. Re-inspect and fully probe completed seams at end of each workday.

3.10 PROTECTION

A. Upon completion of roofing system installation, institute appropriate procedures for protection of completed roofing during remainder of construction period until Project is turned over to the Owner.

B. Make every effort to keep workers off completed roof. Obtain prior approval from Roofing Manufacturer and LTF Construction Project Manager and provide all required membrane protection should it be necessary for workers to access and work on completed roofing membrane.

C. Remove sharp construction debris materials such as loose fasteners and plates, metal strapping, metal clips, sheet metal trimmings, conduit and pipe scrap, nails, etc. immediately and place in protective containers. Remove waste material, packaging material, and construction debris from the roof surface on a daily basis.

D. Partial and Final Inspections:
   1. Inspection: Inspection by Manufacturer: Provide and 50-percent completion and final inspection of the roofing system by a Technical Representative employed by roofing system manufacturer specifically to inspect installation for warranty purposes (i.e. not a sales person).
   2. Perform all corrections necessary for issuance of warranty.
   3. Submit confirmation of completed punchlist to LTF Construction Project Manager.

E. Repairs: Repair and replace, as required deteriorated or defective roofing found at final inspection.

F. Warranty: Warranty period shall commence with date of completion as defined in warranty of manufacturer.

END OF SECTION

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SECTION 07 62 00
SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Prefinished cap flashings.
   2. Counter-flashing over roof membrane base flashings.
   3. Roof joint cover flashings.
   4. Counter flashing at roof mounted mechanical equipment and vent stacks.

1.02 RELATED SECTIONS

A. Section 01 33 00 - Submittal Procedures.

B. Section 01 40 00 - Quality Requirements.

C. Section 01 60 00 - Product Requirements.

D. Section 04 20 00 - Unit Masonry Assemblies.

E. Section 06 10 00 - Rough Carpentry.

F. Section 07 08 00 - Commissioning of Thermal and Moisture Protection.

G. Section 07 42 00 - Metal Wall Panels.

H. Section 07 46 33 - Phenolic Wall Siding.

I. Section 07 54 23 - Thermoplastic Polyolefin (TPO) Roofing.

J. Section 07 72 33 - Roof Hatches.

K. Section 07 92 00 - Joint Sealants.

L. Section 08 41 13 - Aluminum Framed Entrances and Storefronts.

M. Section 08 44 13 - Glazed Aluminum Storefront.

N. Section 23 74 13 - Packaged, Outdoor, Air-Handling Units.

1.03 REFERENCE STANDARDS

A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum 2014 (2015 Errata).

B. ANSI/SPRI/FM 4435/ES-1 - Test Standard for Edge Systems Used with Low Slope Roofing Systems; 2022.

C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

D. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.

E. ASTM D226/D226M - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing; 2017 (Reapproved 2023).

F. ASTM D962 - Standard Specification for Aluminum Powder and Paste Pigments for Paints; Current ed..

G. FM 1-49 - FM Global Loss Prevention Data Sheet; Current ed..

H. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.04 SYSTEM DESCRIPTION

A. Work of this Section is to physically protect related work from damage that would permit water leakage to building interior.

B. Roof perimeter flashing installations to meet requirements of FM 1-49.

1.05 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. General workmanship to comply with recommendations of Revere's "Copper and Common Sense" standards for detail and SMACNA (ASMM) architectural sheet metal manual.

C. Applicator: Company specializing in sheet metal flashing work with three years minimum experience.

1.06 SUBMITTALS

A. Material and Equipment Submittals:
   1. Shop Drawings: Describe material profile, jointing pattern, jointing details, fastening methods, and installation details.
   2. Samples: Submit 6" x 6" samples of prefinished sheet metal for color approval.

B. Certifications, test reports, and calculations showing that all roofing edge metal meet the requirements of ANSI/SPRI/FM 4435/ES-1.

C. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.
   3. See Sections 01 33 00 and 01 60 00.

D. Closeout Submittals:
   1. Warranty.

1.07 STORAGE AND HANDLING

A. Store products under provisions of Section 01 60 00 - Product Requirements.

B. Stack preformed and prefinished material to prevent twisting, bending, or abrasion, and to provide ventilation.

C. Prevent contact with materials during storage which may cause discoloration, staining, or damage.

D. Discard and replace materials that are damaged during storage or installation.

1.08 WARRANTY

A. Watertightness Warranty: Provide five (5) year warranty signed by Contractor and installer for water tightness.

B. Finish Warranty: Provide manufacturer's standard 20 year warranty covering color fade, chalking and film integrity; agreeing to replace, without additional cost, flashing which fails in materials or workmanship.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.

C. Sheet Metal Standard for Copper: Comply with CDA's "Copper in Architecture Handbook." Conform to dimensions and profiles shown unless more stringent requirements are indicated.

D. SPRI Wind Design Standard: Manufacture and install roof edge flashings tested according to ANSI/SPRI/FM 4435/ES-1 and capable of resisting the following design pressure:
   1. Design Pressure: As indicated on Drawings.

E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
   1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.02 SHEET MATERIALS

A. Cap Flashings: Pre-coated galvanized steel; ASTM A653/A653M, G90; 24 gage minimum core steel, shop pre-coated with fluoropolymer coating.
   1. Firestone, Una-Clad.
   2. Peterson Aluminum Corporation, Pac-Clad.
   3. AlumaKlad/ColorKlad.
   4. Or Approved Substitution.
   5. Colors: T.B.D. - as selected and verified by Architect from the full line of available colors.

B. Non-Coated Galvanized Steel: ASTM A653/A653M, G90; 24 gage core steel.

C. Stainless Steel base flashing and drip edges: ASTM A666, Type 304 alloy, soft temper, 28 gage, (0.0156 inch) (0.40 mm) thick; smooth No. 4 - Brushed finish.

2.03 GAUGES OF SHEET METAL

A. As indicated on Drawings. Where not indicated, use galvanized steel of minimum gauges as follows:
   1. Fascias, coping, and roof 24 gauge flashing with an exposed vertical face of 8" or less.
   2. Fascias, coping, and roof 22 gauge flashing with an exposed vertical face of 8" to 10".
   3. Fascias, coping, and roof 20 gauge flashing with an exposed vertical face of 10" to 15".
   4. Hook strips and keepers: 22 gauge (Minimum one gauge heavier that the flashing is securing).
   5. Other sheet metal work: 24 gauge.

B. Provide thicker gauge of sheet metal where required to meet ANSI/SPRI/FM 4435/ES-1.

2.04 FASCIA

A. Fascia Anchor Bar and cover:
   1. Manufacturer and Product:
      a. Elevate, Anchor-Gard SP.
      b. Or approved equal.
   2. Galvanized Steel Fascia anchor bar
      a. Size: See detail
      b. Gauge: 22 or 24 Ga, according to wind requirements
   3. Cover
      a. Cover gauge and profile by Manufacturer.
      b. Cover color: Match cap flashing.
   4. Quality Requirements:
      a. Complies with IBC requirements for ANSI/SPRI/FM 4435/ES-1 testing.
      b. FM Approved for wind uplift
      c. Miami-Dade approved for High Velocity Hurricane Zone of the Florida Building Code.

2.05 ACCESSORIES

A. Fastener: Galvanized steel or stainless steel with soft neoprene washers at exposed fasteners. Finish exposed fasteners same as flashing metal.

B. Underlayment: ASTM D226/D226M; No.15 asphalt saturated roofing felt.

C. Protective Backing Paint: Bituminous.

D. Slip Sheet: Rosin sized building paper.

E. Sealant: SLNT-1, as specified in Section 07 92 00 - Joint Sealers.

F. Bedding Compound: Type compatible with materials with which it will come in contact.

G. Plastic Cement: Type compatible with materials with which it will come in contact.

H. Ice and Water Protection: Sheet membrane of rubberized asphalt bonded to sheet polyethylene with strippable release paper protecting rubberized asphalt side of membrane; 40 mil total membrane thickness; 36" wide. To be installed in all roof valleys and as starter strip 42” from bottom edge of roof. Unless other stated in manufactures recommended installation guidelines.
   1. GCP Vycor v40.
   2. Carlisle, WIP 300 HT.
   3. Or approved substitution.

I. Aluminum Foil Separation Tape: Where sheet membrane flashing comes in contact with incompatible material. See details, manufacturer's recommendations.
   1. 3M Venture Tape; Building Facing Tape.
   2. Or approved substitution.

2.06 FABRICATION

A. Form sections true to shape, accurate in size, square, and free from distortion or defects.

B. Fabricate cleats and starter strips of same material as sheet, interlockable with sheet.

C. Form pieces in longest practical lengths; minimum 12 feet.

D. Hem exposed edges on underside 1/2 inch; miter and seam corners. Use release tape, un-cored membrane and metal cover plate for seam construction.
   1. Base flashing and drip edges adjacent to exterior walking, seating or play areas shall have preformed corners without exposed sharp edges.

E. Form material with cover plate seam. Use release tape, un-cored membrane and metal cover plate for seam construction.

F. Fabricate corners from one piece with minimum 18 inch long legs; seam for rigidity, seal with sealant. Use release tape, un-cored membrane and metal cover plate for seam construction.

G. Fabricate vertical faces with bottom edge formed outward 1/4" and hemmed to form drip.

H. Form sheet metal pans 6 inch nominal square size, seal all seams in flashing watertight. Use Roof Membrane coated metal if required by roof system manufacture with 3 inch upstand, and 4 inch flanges. Fill pans watertight with pourable sealer.

2.07 FINISH

A. Typical Surfaces:
   1. Shop prepare and prime exposed ferrous metal surfaces.
   2. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.
   1. Verify compliance with requirements for installation tolerances of substrates.
   2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
   3. Verify roof openings, curbs, pipes, sleeves, ducts, or vents through roof are solidly set, cant strips and reglets in place, and nailing strips located.
   4. Verify membrane termination and base flashings are in place, sealed, and secure.
   5. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Proceed with installation only after unsatisfactory conditions have been corrected.
   1. Beginning of installation means acceptance of existing conditions.

3.02 PREPARATION

A. Field measure site conditions prior to fabricating work.

B. Install starter and edge strips, and cleats before starting installation.

C. Install surface mounted reglets true to lines and levels. Seal top of reglets with sealant.

D. Insert flashings into reglets to form tight fit. Secure in place with lead or plastic wedges at maximum 24 inches on center. Seal flashings into reglets with sealant.

E. Secure flashings in place using concealed fasteners. Use exposed fasteners only in locations approved by Architect.

F. Seam and seal all joints. Use release tape, un-cored membrane and metal cover plate for seam construction.

G. Fit flashings tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.

H. Seal metal joints watertight. Use release tape, un-cored membrane and metal cover plate for seam construction.

3.03 UNDERLAYMENT INSTALLATION

A. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Prime substrate if recommended by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps and edges with roller. Cover underlayment within 14 days.

B. Apply slip sheet, wrinkle free, directly on substrate before installing sheet metal flashing and trim.

3.04 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
   1. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
   2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
   3. Space cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
   4. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.
   5. Torch cutting of sheet metal flashing and trim is not permitted.
   6. Do not use graphite pencils to mark metal surfaces.
   7. Conform to drawing details included in SMACNA Architectural Sheet Metal manual and the 8th edition of Copper and Common Sense (by Revere).

B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.
   1. Coat concealed side of stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
   2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.
   1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
   2. Use lapped expansion joints only where indicated on Drawings.

D. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.

E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

F. Seal joints as required for watertight construction.
   1. Use sealant-filled joints unless otherwise indicated. Embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.
   2. Prepare joints and apply sealants to comply with requirements in Section 07 92 00 "Joint Sealants."

G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets with solder to width of 1-1/2 inches; however, reduce pre-tinning where pre-tinned surface would show in completed Work.
   1. Do not solder metallic-coated steel sheet.
   2. Do not pre-tin zinc-tin alloy-coated stainless steel.
   3. Do not use torches for soldering.
   4. Heat surfaces to receive solder, and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.
   5. Stainless-Steel Soldering: Tin edges of uncoated sheets, using solder for stainless steel and acid flux. Promptly remove acid flux residue from metal after tinning and soldering. Comply with solder manufacturer's recommended methods for cleaning and neutralization.

H. Rivets: Rivet joints in zinc where necessary for strength.

3.05 ROOF-DRAINAGE SYSTEM INSTALLATION

A. General: Install sheet metal roof-drainage items to produce complete roof-drainage system according to cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.

B. Conductor Heads: Anchor securely to wall, with elevation of conductor head rim at minimum of 1 inch below gutter discharge.

C. Expansion-Joint Covers: Install expansion-joint covers at locations and of configuration indicated. Lap joints minimum of 4 inches in direction of water flow.

3.06 ROOF FLASHING INSTALLATION

A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard. Provide concealed fasteners where possible, and set units true to line, levels, and slopes. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

B. Fascia installation:
   1. Install Fascia Anchor bar and cover according to Manufacturer’s instructions.
   2. Do not penetrate roof membrane on horizontal surfaces.
   3. Protect Roof membrane during installation.
   4. Coordinate installation with the work of other Trades.

C. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for FM Approvals' listing for required windstorm classification.

D. Copings: Anchor to resist uplift and outward forces according to recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for specified FM Approvals' listing for required windstorm classification.

E. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inches over base flashing. Install stainless-steel draw band and tighten.

F. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints minimum of 4 inches. Secure in waterproof manner by means of interlocking folded seam or blind rivets and sealant, anchor and washer at 36-inch centers unless otherwise indicated.

G. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

3.07 WALL FLASHING INSTALLATION

A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

B. Through-Wall Flashing: Installation of through-wall flashing is specified in Section 04 20 00 "Unit Masonry."

C. Opening Flashings in Frame Construction: Install continuous head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings.

3.08 MISCELLANEOUS FLASHING INSTALLATION

A. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member.

B. Overhead-Piping Safety Pans: Suspend pans from structure above, independent of other overhead items such as equipment, piping, and conduit, unless otherwise indicated on Drawings. Pipe and install drain line to plumbing waste or drainage system.

3.09 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.10 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder.

C. Clean off excess sealants.

D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended by sheet metal flashing and trim manufacturer. Maintain sheet metal flashing and trim in clean condition during construction.

E. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

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SECTION 07 72 33
ROOF HATCHES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Prefabricated roof hatches with integral support curbs, operable hardware, and counter-flashing.
   2. Roof hatch railing system.

1.02 RELATED REQUIREMENTS

A. Section 01 33 00 - Submittal Procedures.

B. Section 01 40 00 - Quality Requirements.

C. Section 01 45 33 - Code-Required Special Inspections and Procedures.

D. Section 01 60 00 - Product Requirements.

E. Section 06 10 00 - Rough Carpentry.

F. Section 07 54 23 - Thermoplastic Polyolefin Roofing.

G. Section 07 62 00 - Sheet Metal Flashing and Trim.

H. Section 07 92 00 - Joint Sealants.

1.03 REFERENCE STANDARDS

A. 29 CFR 1910.23 - Ladders; Current Edition.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.

C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

D. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2020.

E. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.

F. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

G. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.

H. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.

I. ASTM C1311 - Standard Specification for Solvent Release Sealants; 2022.

J. ASTM D4397 - Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications; 2016 (Reapproved 2023).

K. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2007 (Reapproved 2018).

L. ASTM F2329/F2329M - Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners; Current edition.

M. NAAMM AMP 500-06 - Metal Finishes Manual; 2006.

1.04 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00.

1.05 SUBMITTALS

A. Product Data: For each type of roof accessory indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For roof accessories. Include plans, elevations, keyed details, and attachments to other Work. Indicate dimensions, loadings, and special conditions. Distinguish between plant- and field-assembled Work.

C. Pre-Warranty Submittal: Submit “Sample” warranty from membrane manufacturer. Sample warranty shall include manufacturer’s warranty number, duration of warranty, name of project, address of project, and shall identify the roofing contractor and describe the materials and assembly to be installed by this contractor.

D. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.
   3. See Sections 01 33 00 and 01 60 00.

E. Operations and Maintenance: Submit Operation and Maintenance information as specified in 01 77 00 Closeout Procedures.

PART 2 PRODUCTS

2.01 PERFORMANCE CRITERIA

A. Performance Requirements:
   1. General Performance: Roof accessories shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.
   2. U-Value: 0.75 or less per 2021 IECC.

2.02 METAL MATERIALS

A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653/A653M, G90 (Z275) coating designation.
   1. Factory Prime Coating: Where field painting is indicated, apply pretreatment and white or light-colored, factory-applied, baked-on epoxy primer coat, with a minimum dry film thickness of 0.2 mil (0.005 mm).

B. Aluminum Sheet: ASTM B209/B209M, manufacturer's standard alloy for finish required, with temper to suit forming operations and performance required.
   1. Mill Finish: As manufactured.
   2. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil (0.013 mm).

C. Aluminum Extrusions and Tubes: ASTM B221 (ASTM B221M), manufacturer's standard alloy and temper for type of use, finished to match assembly where used, otherwise mill finished.

2.03 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.

B. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, acceptable to authorities having jurisdiction, containing no arsenic or chromium, and complying with AWPA C2; not less than 1-1/2 inches (38 mm) thick.

C. Underlayment:
   1. Polyethylene Sheet: 6 mil (0.15 mm) thick polyethylene sheet complying with ASTM D4397.

D. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:

1. Fasteners for Zinc-Coated or Aluminum-Zinc Alloy-Coated Steel: Series 300 stainless steel or hot-dip zinc-coated steel per ASTM A153/A153M or ASTM F2329/F2329M.
2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.

E. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of foam rubber, sponge neoprene, or cork.

F. Elastomeric Sealant: ASTM C920, elastomeric polymer sealant as recommended by roof accessory manufacturer for installation indicated; low modulus; of type, grade, class, and use classifications required to seal joints and remain watertight.

G. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for expansion joints with limited movement.

H. Asphalt Roofing Cement: ASTM D4586/D4586M, asbestos free, of consistency required for application.

2.04 ROOF HATCH

A. Roof Hatches: Metal roof-hatch units with lids and insulated double-walled curbs, welded or mechanically fastened and sealed corner joints, continuous lid-to-curb counterflashing and weathertight perimeter gasketing, stepped integral metal cant raised the thickness of roof insulation, and integrally formed deck-mounting flange at perimeter bottom.
1. Acceptable Products: Subject to compliance with requirements, provide 1 of the following specified products:
a. Babcock-Davis: BRHU.
b. Bilco Company (The): Type L Roof Hatch.
c. Milcor Inc.: Model No. RCS-3.

B. Type and Size: Single-leaf lid, 30 by 96 inches (762 by 2438 mm) at main roof; single-leaf lid, 36 by 30 inches at Bistro

C. Loads: Minimum 40 pound-force per square foot (1.9 kPa) external live load and 20 pound-force per square foot (0.95 kPa) internal uplift load.

D. Curb Material: Zinc-coated (galvanized) steel sheet, 0.079 inch (2.01 mm) (14 gage) thick.
1. Finish: Mill phosphatized.

E. Cover and Liner: 0.090 inch (2.3 mm) (11 gage) thick aluminum cover with 1 inch (25 mm) thick rigid fiberboard insulation and 0.040 inch (1.02 mm) (18 gage) thick aluminum cover liner.
1. Finish: Mill.

F. Construction:
1. Insulation: Manufacturer's rigid board.
2. Hatch Lid: Opaque, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
3. Curb Liner: Manufacturer's standard, of same material and finish as metal curb.
4. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.
5. Fabricate curbs to minimum height of 12 inches (305 mm) unless otherwise indicated.

G. Hardware: Galvanized Stainless-steel spring latch with turn handles, butt- or pintle-type hinge system, and padlock hasps inside and outside.
1. Provide 2-point latch on lids larger than 84 inches (2134 mm).

2.05 ROOF HATCH RAIL SYSTEM

A. Furnish and install hatch rail system at all roof hatches shown on plans. The hatch rail system shall be field assembled and installed per the manufacturer’s instructions.

B. Performance characteristics:
1. High visibility safety yellow color shall be molded in.
2. Hatch rail system shall attach to the capflashing of the roof hatch and shall not penetrate any roofing material.

3. Hatch rail system shall satisfy the requirements of OSHA 29 CFR 1910.23 and shall meet OSHA strength requirements with a factor of safety of two.
4. UV and corrosion resistant construction with a twenty-five year warranty.
5. Self-closing gate shall be provided with hatch rail system.
6. Posts and Rails: Shall be round pultruded reinforced fire retardant yellow fiberglass treated with a UV inhibitor.

C. Hardware: Mounting brackets shall be ¼" thick hot dip galvanized steel. Hinges and post guides shall be 6063T5 aluminum. Fasteners shall be Type 316 stainless steel.

2.06 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM AMP 500-06 "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within range of approved Samples and are assembled or installed to minimize contrast.

PART 3 EXECUTION

3.01 INSTALLATION

A. General: Install roof accessories per manufacturer's written instructions.
1. Install roof accessories level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil canning, buckling, or tool marks.
2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
1. Coat concealed side of uncoated aluminum roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet, or install a course of polyethylene sheet.
3. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof accessories for waterproof performance.

C. Roof-Hatch Installation:
1. Install roof hatch so top surface of hatch curb is level.
2. Verify that roof hatch operates properly. Clean, lubricate, and adjust operating mechanism and hardware.
3. Attach safety railing system to roof-hatch curb.
4. Coordinated with installation of roof assembly installation to provide a continuous air/ vapor/ water/ thermal protection.

D. Seal joints with sealant as required by roof accessory manufacturer.

3.02 REPAIR AND CLEANING

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing per ASTM A780/A780M.

B. Clean exposed surfaces per manufacturer's written instructions.

C. Clean off excess sealants.

D. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 07 81 00
APPLIED FIREPROOFING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Sprayed fire-resistive materials (SFRM).
   2. Thermal Barrier for installation at closed-cell spray foam insulation not directly covered by gypsum board.

1.02 RELATED SECTIONS

A. Section 01 33 00 - Submittal Procedures.

B. Section 01 40 00 - Quality Requirements.

C. Section 01 45 33 - Code-Required Special Inspections and Procedures.

D. Section 01 60 00 - Product Requirements.

E. Section 05 12 00 - Structural Steel Framing

F. Section 05 31 00 - Steel Decking

G. Section 05 40 00 - Cold-Formed Metal Framing

H. Section 07 21 00 - Thermal Insulation.

I. Section 07 81 60 - Intumescent Fireproofing.

J. Section 07 84 00 - Firestopping.

1.03 REFERENCE STANDARDS

A. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.

B. ASTM D3274 - Standard Test Method for Evaluating Degree of Surface Disfigurement of Paint Films by Fungal or Algal Growth, or Soil and Dirt Accumulation; Current Edition, Including All Revisions.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

D. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.

E. ASTM E136 - Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 Degrees C; 2024.

F. ASTM E605/E605M - Standard Test Methods for Thickness and Density of Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members; 2019 (Reapproved 2023).

G. ASTM E736/E736M - Standard Test Method for Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members; 2019 (Reapproved 2023).

H. ASTM E759/E759M - Standard Test Method for Effect of Deflection on Sprayed Fire-Resistive Material Applied to Structural Members; 1992 (Reapproved 2023).

I. ASTM E760/E760M - Standard Test Method for Effect of Impact on Bonding of Sprayed Fire-Resistive Material Applied to Structural Members; 1992 (Reapproved 2023).

J. ASTM E761/E761M - Standard Test Method for Compressive Strength of Sprayed Fire-Resistive Material Applied to Structural Members; 1992 (Reapproved 2023).

K. ASTM E859/E859M - Standard Test Method for Air Erosion of Sprayed Fire-Resistive Materials (SFRMs) Applied to Structural Members; 2023.

L. ASTM E937/E937M - Standard Test Method for Corrosion of Steel by Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members; 1993 (Reapproved 2023).

M. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, with Editorial Revision (2021).

N. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

O. ICC-ES AC23 - Sprayed Fire-resistant Materials (SFRMs), Intumescent Fire-resistant Coatings and Mastic Fire-resistant Coatings Used to Protect Structural Steel Members; Current Edition, Including All Revisions.

P. UL 263 - Standard for Fire Tests of Building Construction and Materials; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Meetings: Conduct meeting at Project site to comply with requirements in Section 01 31 00 – Project Management and Coordination.
   1. Review methods and procedures related to SFRM.
   2. Review products, design ratings, restrained and unrestrained conditions, densities, thicknesses, bond strengths, and other performance requirements.

1.05 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Framing plans, schedules, or both, indicating the following:
   1. Extent of fireproofing for each construction and fire-resistance rating.
   2. Applicable fire-resistance design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.
   3. Minimum fireproofing thicknesses needed to achieve required fire-resistance rating of each structural component and assembly.
   4. Treatment of fireproofing after application.

1.06 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For each type of fireproofing.
   1. Provide fire-rated assembly ratings to UL Design Nos. as shown on Drawings.

C. Evaluation Reports: For fireproofing, from ICC-ES AC23.

D. Preconstruction Test Reports: For fireproofing.

E. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.
   3. See Sections 01 33 00 and 01 60 00.

F. Field quality-control reports.

G. Perform and submit reports of Code Required Special Inspections as required in Section 01 45 33.

1.07 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by fireproofing manufacturer as experienced and with sufficient trained staff to install manufacturer's products per specified requirements.

1.08 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Owner will engage qualified testing agency to perform preconstruction testing on field mock-ups of fireproofing.
   1. Provide test specimens and assemblies representative of proposed materials and construction.

B. Preconstruction Adhesion and Compatibility Testing: Test for compliance with requirements for specified performance and test methods.

1. Bond Strength: Test for cohesive and adhesive strength per ASTM E736/E736M. Provide bond strength indicated in referenced fire-resistance design, but not less than minimum specified in Part 2.
2. Density: Test for density per ASTM E605/E605M. Provide density indicated in referenced fire-resistance design, but not less than minimum specified in Part 2.
3. Verify that manufacturer, through its own laboratory testing or field experience, attests that primers or coatings are compatible with fireproofing.
4. Schedule sufficient time for testing and analyzing results to prevent delaying Work.
5. For materials failing tests, obtain applied-fireproofing manufacturer's written instructions for corrective measures including use of specially formulated bonding agents or primers.

1.09 FIELD CONDITIONS

A. Environmental Limitations: Do not apply fireproofing when ambient or substrate temperature is 44 degrees F (7 degrees C) or lower unless temporary protection and heat are provided to maintain temperature at or above this level for 24 hours before, during, and for 24 hours after product application.

B. Ventilation: Ventilate building spaces during and after application of fireproofing, providing complete air exchanges per manufacturer's written instructions. Use natural means or, if they are inadequate, forced-air circulation until fireproofing dries thoroughly.

PART 2 PRODUCTS

2.01 MATERIALS, GENERAL

A. Assemblies: Provide fireproofing, including auxiliary materials, per requirements of each fire-resistance design and manufacturer's written instructions.

B. Source Limitations: Obtain fireproofing for each fire-resistance design from single source.

C. Fire-Resistance Design: Indicated on Drawings, tested per ASTM E119 or UL 263 by qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Steel members are to be considered unrestrained unless specifically noted otherwise.

D. VOC Content: Products shall comply with VOC content limits of authorities having jurisdiction.

E. Asbestos: Provide products containing no detectable asbestos.

2.02 SPRAYED FIRE-RESISTIVE MATERIALS

A. SFRM: Manufacturer's standard, factory-mixed, lightweight, dry formulation, complying with indicated fire-resistance design, and mixed with water at Project site to form a slurry or mortar before conveyance and application or conveyed in a dry state and mixed with atomized water at place of application.

B. Low Density, Concealed/Commercial SFRMs:
1. Products: Subject to compliance with requirements, provide one of the following:
   a. Carboline Company, subsidiary of RPM International, Fireproofing Products Div.: Pyrolite 15 High Yield.
   b. Grace, W. R. & Co. - Conn.; Grace Construction Products: Monokote MK-6 Series.
   c. Isolatek International: Cafco Blaze-Shield II, Cafco 300.
   d. Southwest Fireproofing Products Co.: Type 5GP. Southwest is a Carboline Co.
   e. Or approved equal.
2. Physical Properties:
   a. Bond Strength: Minimum 150-lbf/sq. ft. (7.18-kPa) (20.59-kPa) (47.88-kPa), cohesive and adhesive strength based on field testing according to ASTM E 736.
   b. Density: Not less than 15 lb/cu. ft. and as specified in the approved fire-resistance design, per ASTM E605/E605M.
   c. Thickness: As required for fire-resistance design indicated, measured per requirements of fire-resistance design or ASTM E605/E605M, whichever is thicker, but not less than 0.375 inch (9 mm).

d. Combustion Characteristics: When tested in accordance with ASTM E136 shall be noncombustible.
e. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1) Flame-Spread Index: 10 or less.
2) Smoke-Developed Index: 10 or less.
f. Compressive Strength: When tested in accordance with ASTM E761/E761M, the material shall not deform more than 10 percent when subjected to a crushing force of 1,440 psf.
g. Corrosion Resistance: No evidence of corrosion per ASTM E937/E937M.
h. Deflection: No cracking, spalling, or delamination per ASTM E759/E759M.
i. Effect of Impact on Bonding: No cracking, spalling, or delamination per ASTM ASTM E760/E760M.
j. Air Erosion: Maximum weight loss of 0.025 grams per square foot (0.270 g/sq. m) in 24 hours per ASTM E859/E859M.
k. Fungal Resistance: Treat products with manufacturer's standard antimicrobial formulation to result in no growth on specimens per ASTM G21 or rating of 10 per ASTM D3274 when tested per ASTM D3273.

C. Medium Density SFRMs.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Isolatek International: Cafco 400.
b. Grace, W. R. & Co. - Conn.; Grace Construction Products: MonoKote Z-106/G.
c. Southwest Fireproofing Products Co.: Type 7GP.
d. Or approved equal.
2. Physical Properties:
a. Bond Strength: Minimum 430-lbf/sq. ft. (7.18-kPa) (20.59-kPa) (47.88-kPa), cohesive and adhesive strength based on field testing according to ASTM E 736.
b. Density: Not less than 22 lb/cu. ft. and as specified in the approved fire-resistance design, per ASTM E605/E605M.
c. Thickness: As required for fire-resistance design indicated, measured per requirements of fire-resistance design or ASTM E605/E605M, whichever is thicker, but not less than 0.375 inch (9 mm).
d. Combustion Characteristics: ASTM E136.
e. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1) Flame-Spread Index: 10 or less.
2) Smoke-Developed Index: 10 or less.
f. Compressive Strength: When tested in accordance with ASTM E761/E761M, the material shall not deform more than 10 percent when subjected to a crushing force of 7,344 psf.
g. Corrosion Resistance: No evidence of corrosion per ASTM E937/E937M.
h. Deflection: No cracking, spalling, or delamination per ASTM E759/E759M.
i. Effect of Impact on Bonding: No cracking, spalling, or delamination per ASTM E760/E760M.
j. Air Erosion: Maximum weight loss of 0.025 grams per square foot (0.270 g/sq. m) in 24 hours per ASTM E859/E859M.
k. Fungal Resistance: Treat products with manufacturer's standard antimicrobial formulation to result in no growth on specimens per ASTM G21 or rating of 10 per ASTM D3274 when tested per ASTM D3273.

D. Medium Density, Moisture Resistant SFRMs.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Isolatek International: Blaze-Shield HP.
b. Grace, W. R. & Co. - Conn.; Grace Construction Products: MonoKote Z-106HY.
c. Southwest Fireproofing Products Co.: Type 7HD.
d. Or approved equal.
2. Physical Properties:

a. Bond Strength: Minimum 430-lbf/sq. ft. (7.18-kPa) (20.59-kPa) (47.88-kPa), cohesive and adhesive strength based on field testing according to ASTM E736/E736M.
b. Density: Not less than 22 lb/cu. ft. and as specified in the approved fire-resistance design, per ASTM E605/E605M.
c. Thickness: As required for fire-resistance design indicated, measured per requirements of fire-resistance design or ASTM E605/E605M, whichever is thicker, but not less than 0.375 inch (9 mm).
d. Combustion Characteristics: ASTM E136.
e. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
    1) Flame-Spread Index: 10 or less.
    2) Smoke-Developed Index: 10 or less.
f. Compressive Strength: When tested in accordance with ASTM E761/E761M, the material shall not deform more than 10 percent when subjected to a crushing force of 7,344 psf.
g. Corrosion Resistance: No evidence of corrosion per ASTM E937/E937M.
h. Deflection: No cracking, spalling, or delamination per ASTM E759/E759M.
i. Effect of Impact on Bonding: No cracking, spalling, or delamination per ASTM E760/E760M.
j. Air Erosion: Maximum weight loss of 0.025 grams per square foot (0.270 g/sq. m) in 24 hours per ASTM E859/E859M.
k. Fungal Resistance: Treat products with manufacturer's standard antimicrobial formulation to result in no growth on specimens per ASTM G21 or rating of 10 per ASTM D3274 when tested per ASTM D3273.

2.03 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that are compatible with fireproofing and substrates and are approved by UL or another testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistance designs indicated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrates and other conditions affecting performance of Work and per each fire-resistance design. Verify compliance with the following:
    1. Substrates are free of dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, incompatible primers, paints, and encapsulants, or other foreign substances capable of impairing bond of fireproofing with substrates under conditions of normal use or fire exposure.
    2. Objects penetrating fireproofing, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
    3. Substrates receiving fireproofing are not obstructed by ducts, piping, equipment, or other suspended construction that will interfere with fireproofing application.

B. Verify that roof construction, installation of roof-top HVAC equipment, and other related Work is complete before beginning fireproofing Work.

C. Conduct tests per fireproofing manufacturer's written recommendations to verify that substrates are free of substances capable of interfering with bond.

D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of Work.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Cover other Work subject to damage from fallout or overspray of fireproofing materials during application.

B. Clean substrates of substances that could impair bond of fireproofing.

3.03 APPLICATION

A. Construct fireproofing assemblies that are identical to fire-resistance design indicated and products as specified, tested, and substantiated by test reports; for thickness, primers, and other materials and procedures affecting fireproofing Work.

B. Comply with fireproofing manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and apply fireproofing; as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.

C. Coordinate application of fireproofing with other construction to minimize need to cut or remove fireproofing.
   1. Do not begin applying fireproofing until clips, hangers, supports, sleeves, and other items penetrating fireproofing are in place.
   2. Defer installing ducts, piping, and other items that would interfere with applying fireproofing until application of fireproofing is completed.

D. Metal Decks:
   1. Do not apply fireproofing to underside of metal roof deck until roofing has been completed; prohibit roof traffic during application and drying of fireproofing.

E. Install auxiliary materials as required, as detailed, and per fire-resistance design and fireproofing manufacturer's written recommendations for conditions of exposure and intended use. For auxiliary materials, use attachment and anchorage devices of type recommended in writing by fireproofing manufacturer.

F. Spray apply fireproofing to maximum extent possible. Following spraying operation in each area, complete coverage by trowel application or other placement method recommended in writing by fireproofing manufacturer.

G. Extend fireproofing in full thickness over entire area of each substrate to be protected.

H. Install body of fireproofing in single course unless otherwise recommended in writing by fireproofing manufacturer.

I. Provide a uniform finish complying with description indicated for each type of fireproofing material and matching finish approved for required mock-ups.

J. Cure fireproofing per fireproofing manufacturer's written recommendations.

K. Do not install enclosing or concealing construction until after fireproofing has been applied, inspected, and tested and corrections have been made to deficient applications.

L. Finishes: Where indicated, apply fireproofing to produce the following finishes:
   1. Manufacturer's Standard Finishes: Finish per manufacturer's written instructions for each finish selected.
   2. Spray-Textured Finish: Finish left as spray applied with no further treatment.

3.04 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage qualified special inspector to perform the following special inspections:
   1. Test and inspect as required by the ICC (IBC), 1704.10.

B. Perform tests and inspections of completed Work in successive stages. Do not proceed with application of fireproofing for next area until test results for previously completed applications of fireproofing show compliance with requirements. Tested values must equal or exceed values as specified and as indicated and required for approved fire-resistance design.

C. Fireproofing will be considered defective if it does not pass tests and inspections.
   1. Remove and replace fireproofing that does not pass tests and inspections, and retest.
   2. Apply additional fireproofing, per manufacturer's written instructions, where test results indicate insufficient thickness, and retest.

D. Prepare test and inspection reports.

3.05 CLEANING, PROTECTING, AND REPAIRING

A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.

B. Protect fireproofing, per advice of manufacturer and Installer, from damage resulting from construction operations or other causes, so fireproofing will be without damage or deterioration at time of Substantial Completion.

C. As installation of other construction proceeds, inspect fireproofing and repair damaged areas and fireproofing removed due to Work of other trades.

D. Repair fireproofing damaged by other Work before concealing it with other construction.

E. Repair fireproofing by reapplying it using same method as original installation or using manufacturer's recommended trowel-applied product.

END OF SECTION

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SECTION 07 81 60
INTUMESCENT FIREPROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Spray applied intumescent fireproofing on interior structural steel.

B. Preparation of surfaces and protection of adjacent surfaces.

C. Topcoat protective decorative finish.

1.02 RELATED SECTIONS

A. Section 01 33 00 - Submittal Procedures.

B. Section 01 40 00 - Quality Requirements.

C. Section 01 45 33 - Code-Required Special Inspections and Procedures.

D. Section 01 60 00 - Product Requirements.

E. Section 05 12 00 - Structural Steel: Requirements for substrates receiving sprayed fire-resistive materials.

F. Section 07 81 00 - Applied Fireproofing: Requirements for and application of mineral fiber and cementitious fireproofing.

G. Section 09 91 00 - Painting.

1.03 REFERENCES

A. Underwriters Laboratories (UL) Fire Resistance Directory.

B. American Society for Testing and Materials (ASTM):
   1. ASTM D256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics.
   2. ASTM D638 - Standard Test Method for Tensile Properties of Plastics.
   3. ASTM D695 - Standard Test Method for Compressive Properties of Rigid Plastics.
   4. ASTM D696 - Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30 degrees C and 30 degrees C With a Vitreous Silica Dilatometer.
   5. ASTM D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
   6. ASTM D952 - Standard Test Method for Bond or Cohesive Strength of Sheet Plastics and Electrical Insulating Materials.
   7. ASTM D1002 - Standard Test Method for Apparent Shear Strength of Single-Lap-Joint Adhesively Bonded Metal Specimens by Tension Loading (Metal-to-Metal).
   8. ASTM D1044 - Standard Test Method for Resistance of Transparent Plastics to Surface Abrasion.
   9. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness.
   10. ASTM D4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.
   11. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
   12. ASTM E605 - Standard Test Methods for Thickness and Density of Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members.
   13. ASTM E760 - Standard Test Method for Effect of Impact on Bonding of Sprayed Fire-Resistive Material Applied to Structural Members.
   14. ASTM F433 - Standard Practice for Evaluating Thermal Conductivity of Gasket Materials.

C. Steel Structures Painting Council (SSPC) Surface Preparation Standards.

D. Material manufacturer's current published information including, but not limited to, application guide.

E. AWCI Technical Manual 12-B "Standard Practice for the Testing and Inspection of Field Applied Thin-Film Intumescent Fire-Resistive Materials; an Annotated Guide", Latest Edition.

F. The Society for Protective Coatings (SSPC):
   1. SSPC-SP 1 - Solvent Cleaning.
   2. SSPC-SP 2 - Hand Tool Cleaning.
   3. SSPC-SP 3 - Power Tool Cleaning.
   4. SSPC-SP 6 - Commercial Blast Cleaning.

1.04 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Manufacturer's data sheets on each product to be used, including:
   1. UL Design Listings for specific applications required.
   2. Storage and handling requirements and recommendations.
   3. Field application manual.

C. Samples:
   1. Two sets of samples representing anticipated texture and finish.
   2. Submit Topcoat color options for Architect selection.

D. Certification: Obtain and submit certification by authority having jurisdiction that fireproofing products are acceptable.

E. Installer's qualification statement indicating installer is approved by the manufacturer as an installer.

F. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.
   3. See Sections 01 33 00 and 01 60 00.

G. Perform and submit reports of Code Required Special Inspections as required in Section 01 45 33.

1.05 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Manufacturer Qualifications: Company specializing in the manufacture of the products specified, with minimum of 20 years documented experience.

C. Installer Qualifications: Trained and approved by manufacturer, with minimum of 5 years documented experience.

D. Fire-Resistance Ratings: As indicated by UL Fire Resistance Directory designation.

E. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
   1. Finish at least 100 sq ft in area designated by Architect.
   2. Evaluate mock-up for compliance with specified requirements, including thickness and finish texture.
   3. Refinish mock-up area as required to produce acceptable work.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.07 PROJECT CONDITIONS

A. When the temperature at the job site is less than 50º F (10º C), a minimum substrate and ambient temperature of 50º F (10º C) shall be maintained prior to, during, and a minimum of 72 hours after application. If necessary for job schedule, the General Contractor shall provide enclosures and heat to maintain proper temperatures and humidity levels in the application areas.

B. In enclosed areas, ventilation shall not be less than 4 complete air exchanges per hour until the material is dry.

C. Relative humidity shall not exceed 85% throughout the total period of application and drying for the intumescent fire resistive material, and must not exceed 85% throughout the application and drying for the protective decorative topcoat.

1.08 WARRANTY

A. Provide manufacturer's standard warranty for intumescent fireproofing.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design Manufacturer: Hilti.

B. Approved Alternate manufacturer: Isolatek International.

C. Accepted substitutions in accordance with provisions of Section 01 60 00.

2.02 MATERIALS

A. Primer: As recommended by fireproofing manufacturer, to suit substrate.
   1. Acceptable Products and Manufacturers:
      a. Amerlock® 2, Two-component, high solids epoxy coating; PPG Industries, Inc, Architectural Coatings.
      b. Or approved equal.
   2. Acceptable substitutions in accordance with provisions of Section 01 60 00.
      a. Substituted products must be certified by Manufacturer of Intumescent Fire-Protection System as compatible with their product.

B. Intumescent Fire-Protection System:
   1. Wet areas: Acceptable Products and Manufacturers:
      a. Hilti Fire Finish 120+ CFP-SP WB by Hilti.
      b. Cafco SprayFilm WB 4 by Isolatek International.
      c. Or approved equal.
   2. Dry areas: Acceptable Products and Manufacturers:
      a. Hilti Fire Finish 120+ CFP-SP WB by Hilti.
      b. Cafco SprayFilm WB 5 by Isolatek International.
      c. A/D Firefilm III by Carboline.
      d. Or approved equal.
   3. Acceptable substitutions in accordance with provisions of Section 01 60 00.
   4. Intumescent fire resistive material shall be applied in accordance with drawings and/or specifications, and shall have been tested in accordance with the procedures of ANSI/UL 263 or ASTM E119 or CAN/ULC-S101, and reported by Underwriters Laboratories, Inc. or Underwriters Laboratories of Canada only.
   5. Thin-Film Fire-Resistive Intumescent Mastic Coating: Factory-mixed formulation.
   6. Water-Based Formulation: Approved by manufacturer and authorities having jurisdiction for indicated use.
   7. Water-Based Formulation: Approved by manufacturer and authorities having jurisdiction for indicated use.
   8. Verify with manufacturer that products selected are suitable for use indicated.
   9. UL Fire Tested Designs Only based on ANSI/UL 263 (ASTM E119).
   10. Minimum Shore D Hardness of 40 before the topcoat and finish coat is applied.
   11. Meet UL Interior General Purpose Classification Requirements without any topcoat.
   12. To assure an acceptable Architectural finish, no mesh is allowed.
   13. A representative mock-up sprayed Architectural finish sample must be submitted, reviewed, and accepted by the architect in advance.

C. Topcoat: Flexible aliphatic polyurethane coating recommended by fireproofing manufacturer.

1. Topcoat materials shall be as required for color-coding, aesthetics or additional surface protection, and approved by the thin-film fire resistive material manufacturer.
2. Acceptable Products and Manufacturer, as approved by Fire-Protection product Manufacturer:
   a. Durethane® DTM Urethane Mastic; PPG Industries, Inc, Architectural Coatings.
   b. Or approved equal.
3. Acceptable substitutions in accordance with provisions of Section 01 60 00.
   a. Substituted products must be certified by Manufacturer of Intumescent Fire-Protection System as compatible with their product.
4. Color:
   a. Match PT-1. See 09 91 00.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Verify that substrates are ready to receive fireproofing.

D. Ensure that all primers applied beneath fireproofing are compatible with the applied fireproofing.

E. Verify that items that need to penetrate the fireproofing film are in place, including clips, hangers, supports, and sleeves.

F. Verify that other work that would obstruct access to surfaces to be fireproofed has not yet been installed.

G. Where fireproofing is to be exposed to view as a finished surface, verify that surfaces are smooth, without voids, cracks, or projections.

H. Start of work constitutes acceptance of substrates.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Clean surfaces of dirt, dust, grease, oil, loose material, and other matter that may affect bond of fireproofing.

D. Clean surfaces in accordance with manufacturer's instructions and SSPC-1, SSPC-2, SSPC-3, or SSPC-6 as required to obtain substrate suitable for installation of fireproofing.

E. Seal penetrations and open ended fireproofing terminations as required by manufacturer.

F. Install durable protective coverings on floors and adjacent walls and ceilings, to protect from overspray, fall-out, and dusting.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Prime all surfaces unless existing primer is suitable and undamaged and compatible with fireproofing.

C. Install fireproofing in sufficient thickness to achieve fire rating indicated. Use as many passes as necessary to cover with a monolithic coating of uniform hardness, density, and texture.
   1. Roll smooth the finished surface.

D. Remove fireproofing from surfaces not specifically required to be fireproofed.

3.04 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed by Owner's independent testing agency.

B. Correct defective work and provide further inspection and testing to verify compliance, at no cost to Owner.

3.05 CLEANING AND PROTECTION

A. Clean fireproofing surfaces as recommended by manufacturer.

B. Remove excess material, overspray, droppings, and debris.

C. Protect installed products until completion of project.

D. Touch-up, repair, or replace damaged products before Substantial Completion.

E. Where fireproofing is subsequently cut away to facilitate installation of other work, patch fireproofing to same thickness and texture after installation of other work at no cost to Owner.

END OF SECTION

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SECTION 07 84 00
FIRESTOPPING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Penetrations in fire-resistance-rated walls.
   2. Penetrations in horizontal assemblies.
   3. Penetrations in smoke barriers.

1.02 SYSTEM DESCRIPTION

SECTION 07 84 00
FIRESTOPPING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Penetrations in fire-resistance-rated walls.
   2. Penetrations in horizontal assemblies.
   3. Penetrations in smoke barriers.

1.02 SYSTEM DESCRIPTION

A. Firestopping shall consist of furnishing and installing a material or a combination of materials to form an effective barrier against the spread of flame, smoke and gases, and maintain the integrity of fire resistance rated walls, partitions, floors, and ceiling-floor assemblies, including through-penetrations and construction joints. Through-penetrations include the annular space around pipes, tubes, conduit, wires, cables and vents. Construction joints include those used to accommodate expansion, contraction, wind, or seismic movement; firestopping material shall not interfere with the required movement of the joint. The following list includes some possible locations and applications, but is not all inclusive:
   1. Penetrations of duct, conduit, tubing, cable and pipe through floors and through fire-resistance rated walls, partitions, and ceiling-floor assemblies.
   2. Penetrations of vertical shafts such as pipe chases, elevator shafts, and utility chutes.
   3. Gaps at the intersection of floor slabs and curtain walls, including inside of hollow curtain walls at the floor slab.
   4. Gaps at the intersection of floor slabs and any exterior wall that is continuous between floors.
   5. Gaps at perimeter of fire-resistance rated walls and partitions, such as between the top of the walls and the bottom of roof decks.
   6. Openings between curtain walls and structural floor slabs.
   7. Construction joints in floors and fire rated walls and partitions.
   8. At expansion joints in walls, floors and wall and floor slab assemblies.
   9. Other existing penetrations at demising walls and other locations where required to maintain fire resistance rating of the construction.

1.03 RELATED SECTIONS

A. Section 01 33 00 - Submittal Procedures.

B. Section 01 45 33 - Code-Required Special Inspections and Procedures.

C. Section 01 40 00 - Quality Requirements.

D. Section 01 60 00 - Product Requirements.

E. Section 03 30 00 - Cast in Place Concrete.

F. Section 04 20 00 - Unit Masonry.

G. Section 05 31 00 - Metal Decking.

H. Section 09 21 16 - Gypsum Board Assemblies.

1.04 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

B. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.

C. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2023a.

D. FM (AG) - FM Approval Guide; Current Edition.

E. FM 4991 - Approval Standard of Firestop Contractors; 2013.

F. ITS (DIR) - Directory of Listed Products; Current Edition.

A. G. UL (FRD) - Fire Resistance Directory; Current Edition.

Firestopping shall consist of furnishing and installing a material or a combination of materials to form an effective barrier against the spread of flame, smoke and gases, and maintain the integrity of fire resistance rated walls, partitions, floors, and ceiling-floor assemblies, including through-penetrations and construction joints. Through-penetrations include the annular space around pipes, tubes, conduit, wires, cables and vents. Construction joints include those used to accommodate expansion, contraction, wind, or seismic movement; firestopping material shall not interfere with the required movement of the joint. The following list includes some possible locations and applications, but is not all inclusive:

1. Penetrations of duct, conduit, tubing, cable and pipe through floors and through fire-resistance rated walls, partitions, and ceiling-floor assemblies.
2. Penetrations of vertical shafts such as pipe chases, elevator shafts, and utility chutes.
3. Gaps at the intersection of floor slabs and curtain walls, including inside of hollow curtain walls at the floor slab.
4. Gaps at the intersection of floor slabs and any exterior wall that is continuous between floors.
5. Gaps at perimeter of fire-resistance rated walls and partitions, such as between the top of the walls and the bottom of roof decks.
6. Openings between curtain walls and structural floor slabs.
7. Construction joints in floors and fire rated walls and partitions.
8. At expansion joints in walls, floors and wall and floor slab assemblies.
9. Other existing penetrations at demising walls and other locations where required to maintain fire resistance rating of the construction.

1.03 RELATED SECTIONS

A. Section 01 33 00 - Submittal Procedures.

B. Section 01 45 33 - Code-Required Special Inspections and Procedures.

C. Section 01 40 00 - Quality Requirements.

D. Section 01 60 00 - Product Requirements.

E. Section 03 30 00 - Cast in Place Concrete.

F. Section 04 20 00 - Unit Masonry.

G. Section 05 31 00 - Metal Decking.

H. Section 09 21 16 - Gypsum Board Assemblies.

1.04 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

B. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.

C. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2023a.

D. FM (AG) - FM Approval Guide; Current Edition.

E. FM 4991 - Approval Standard of Firestop Contractors; 2013.

F. ITS (DIR) - Directory of Listed Products; Current Edition.

G. UL (FRD) - Fire Resistance Directory; Current Edition.

H. UL 263 - Standard for Fire Tests of Building Construction and Materials; Current Edition, Including All Revisions.

I. UL 1479 - Standard for Fire Tests of Penetration Firestops; Current Edition, Including All Revisions.

J. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems; Current Edition, Including All Revisions.

1.05 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Product Schedule: For each penetration firestopping system. Include location and design designation of qualified testing and inspecting agency.

C. Qualification Data: For qualified Installer.

D. Installer Certificates: From Installer indicating penetration firestopping has been installed in compliance with requirements and manufacturer's written recommendations.

E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for penetration firestopping.

F. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.
   3. See Sections 01 33 00 and 01 60 00.

G. Perform and submit reports of Code Required Special Inspections as required in Section 01 45 33.

1.06 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Installer Qualifications: A firm experienced in installing penetration firestopping similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its penetration firestopping products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer. Refer to FM 4991.

C. Fire-Test-Response Characteristics: Penetration firestopping shall comply with the following requirements:
   1. Penetration firestopping tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
   2. Penetration firestopping is identical to those tested per testing standard referenced in "Penetration Firestopping" Article. Provide rated systems complying with the following requirements:
      a. Penetration firestopping products bear classification marking of qualified testing and inspecting agency.
      b. Classification markings on penetration firestopping correspond to designations listed by the following:
         1) UL in its "Fire Resistance Directory." UL (FRD) and UL 263
         2) Intertek ETL SEMKO in its "Directory of Listed Building Products." ITS (DIR)
         3) FM Global in its "Building Materials Approval Guide." FM (AG)

1.07 PROJECT CONDITIONS

A. Environmental Limitations: Do not install penetration firestopping when ambient or substrate temperatures are outside limits permitted by penetration firestopping manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.

B. Install and cure penetration firestopping per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.08 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping is installed according to specified requirements.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Specified Technologies, Inc.

2. Grace Construction Products.
3. Hilti, Inc.
4. Johns Manville.
5. Owen's Corning.
6. RectorSeal Corporation.
7. 3M Fire Protection Products.
8. Tremco, Inc.; Tremco Fire Protection Systems Group.
9. USG Corporation.

2.02 PENETRATION FIRESTOPPING

A. Provide penetration firestopping that is produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

B. Penetrations in Fire-Resistance-Rated Walls: Provide penetration firestopping with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).
   1. Fire-resistance-rated walls include fire-barrier walls.
   2. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

C. Penetrations in Horizontal Assemblies: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).
   1. Horizontal assemblies include floors and ceiling membranes of roof/ceiling assemblies.
   2. F-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated.
   3. T-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall. T-rating to be applied according to the standards of ASTM E119

D. Exposed Penetration Firestopping: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E84.

E. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.
   1. Permanent forming/damming/backing materials, including the following:
      a. Slag-wool-fiber or rock-wool-fiber insulation.
      b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
      c. Fire-rated form board.
      d. Fillers for sealants.
   2. Temporary forming materials.
   3. Substrate primers.
   4. Collars.
   5. Steel sleeves.

2.03 FILL MATERIALS

A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic sleeve lined with an intumescent strip, a radial extended flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.

B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture. Comply with UL 2079

C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant. Comply with UL 1479.

D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized-steel sheet.

E. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.

F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

G. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

H. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.

I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

J. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces, and nonsag formulation for openings in vertical and sloped surfaces, unless indicated firestopping limits use of nonsag grade for both opening conditions.

2.04 MIXING

A. For those products requiring mixing before application, comply with penetration firestopping manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Surface Cleaning: Clean out openings immediately before installing penetration firestopping to comply with manufacturer's written instructions and with the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping.
2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent penetration firestopping from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing firestopping's seal with substrates.

3.03 INSTALLATION

A. General: Install penetration firestopping to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
   1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestopping.

C. Install fill materials for firestopping by proven techniques to produce the following results:
   1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
   2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
   3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.04 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping is without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping and install new materials to produce systems complying with specified requirements.

3.05 PENETRATION FIRESTOPPING SCHEDULE

A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHEZ.

B. Firestopping with No Penetrating Items:
   1. UL-Classified Systems: As indicated.

C. Firestopping for Metallic Pipes, Conduit, or Tubing:
   1. UL-Classified Systems: As indicated.

D. Firestopping for Nonmetallic Pipe, Conduit, or Tubing:
   1. UL-Classified Systems: As indicated.

E. Firestopping for Electrical Cables:
   1. UL-Classified Systems: As indicated.

F. Firestopping for Insulated Pipes:
   1. UL-Classified Systems: As indicated.

G. Firestopping for Miscellaneous Electrical Penetrants:
   1. UL-Classified Systems: As indicated.

H. Firestopping for Miscellaneous Mechanical Penetrants:
   1. UL-Classified Systems: As indicated.

I. Firestopping for Groupings of Penetrants:
   1. UL-Classified Systems: As indicated.
   2. Intertek ETL SEMKO-Listed Systems.
   3. FM Global-Approved Systems.
   4. F-Rating: 2 hours.
   5. T-Rating: 2 hours.
   6. L-Rating at Ambient: As indicated.
   7. L-Rating at 400 deg F (204 deg C): As indicated.

8. Type of Fill Materials: As required to achieve rating.

END OF SECTION

SECTION 07 92 00
JOINT SEALANTS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Hybrid joint sealants.
   2. Silicone joint sealants.
   3. Polyurethane joint sealants.
   4. Latex joint sealants.
   5. Acoustic Joint Sealants.
   6. Glazing Sealants.

B. See Section 13 11 15 – Swimming Pool Finishes: for Sealants around Swimming Pools.

1.02 RELATED SECTIONS

A. Section 01 33 00 - Submittal Procedures.
B. Section 01 40 00 - Quality Requirements.
C. Section 01 60 00 - Product Requirements.
D. Section 03 45 00 - Precast Architectural Concrete.
E. Section 03 45 70 - Architectural Site Cast Concrete Wall Panels
F. Section 04 20 00 - Unit Masonry Assemblies.
G. Section 06 10 00 - Rough Carpentry.
H. Section 06 20 00 - Finish Carpentry.
I. Section 06 40 00 - Architectural Woodwork.
J. Section 06 64 00 - Plastic Paneling.
K. Section 07 08 00 - Commissioning of Thermal and Moisture Protection.
L. Section 07 21 00 - Thermal Insulation.
M. Section 07 24 19 - Water-Drainage Exterior Insulation and Finish System (EIFS).
N. Section 07 24 20 - Polymer-Based Interior Finish System (IFS).
O. Section 07 27 26 - Fluid-Applied Membrane Air Barrier.
P. Section 07 42 00 - Metal Wall Panels.
Q. Section 07 54 23 - Thermoplastic Polyolefin (TPO) Roofing.
R. Section 07 62 00 - Sheet Metal Flashing and Trim.
S. Section 07 72 33 - Roof Hatches.
T. Section 07 81 00 - Applied Fireproofing.
U. Section 07 81 60 - Intumescent Fireproofing.
V. Section 07 84 00 - Firestopping.
W. Section 08 11 13 - Hollow Metal Doors and Frames.
X. Section 08 11 16 - Aluminum Doors and Frames.
Y. Section 08 31 13 - Access Doors and Frames.
Z. Section 08 38 00 - Traffic Doors.
AA. Section 08 41 13 - Aluminum Framed Entrances and Storefronts.
BB. Section 08 42 45 - Sliding Aluminum Doors.
CC. Section 08 81 00 - Glazing.

DD. Section 09 21 16 - Gypsum Board Assemblies.

EE. Section 09 21 17 - Gypsum Board Shaft Wall Assemblies.

FF. Section 09 30 00 - Tiling.

GG. Section 13 11 15 - Swimming Pool Finishes.

1.03 REFERENCE STANDARDS

A. AAMA 802.3 - Specification for Ductile Back Bedding Glazing Compound.

B. AAMA 803.3 - Specification for Narrow Joint Seam Sealers.

C. AAMA 805.2 - Specification for Back Bedding Glazing Compound.

D. AAMA 808.3 - Specification for Exterior Perimeter Sealing Compound.

E. 21 CFR 177 - Indirect Food Additives: Polymers; Current ed..

F. ASTM C717 - Standard Terminology of Building Seals and Sealants; Current Edition.

G. ASTM C719 - Standard Test Method for Adhesion and Cohesion of Elastomeric Joint Sealants Under Cyclic Movement (Hockman Cycle); 2022.

H. ASTM C834 - Standard Specification for Latex Sealants; 2017 (Reapproved 2023).

I. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.

J. ASTM C1021 - Standard Practice for Laboratories Engaged in Testing of Building Sealants; 2008 (Reapproved 2023).

K. ASTM C1184 - Standard Specification for Structural Silicone Sealants; 2023.

L. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016 (Reapproved 2023).

M. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants; 2022.

N. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants; 2023.

O. ASTM C1382 - Standard Test Method for Determining Tensile Adhesion Properties of Sealants When Used in Exterior Insulation and Finish Systems (EIFS) Joints; Current Ed..

P. ASTM C1401 - Standard Guide for Structural Sealant Glazing; 2023.

Q. ASTM C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints; 2019 (Reapproved 2020).

R. ASTM D412 - Test Method for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension.

S. ASTM D2240 - Test Method for Rubber Property - Durometer Hardness.

T. EIMA 300.01 - Determining Peel Adhesion and Tensile Adhesion Properties of Sealants Applied to EIFS Class PB.

U. Federal Specification TT-S-00227E - Sealing Compound, Elastomeric Type, Multi-Component (for Caulking, Sealing, and Glazing in Buildings and Other Structures).

V. Federal Specification TT-S-00230C - Sealing Component, Elastomeric Type, Single Component (for Caulking, Sealing, & Glazing in Buildings and Other Structures).

W. Federal Specification TT-S-001543A - Sealing Compound: Silicone Rubber Base (For Caulking, Sealing, and Glazing in Buildings and Other Structures).

X. Federal Specification TT-S-001543B - Sealing Compound: Silicone Rubber Base (For Caulking, Sealing, and Glazing in Buildings and Other Structures).

Y. GANA - Sealant Manual and Related GANA Publications.

Z. SWRI Sealant Manual and Related SWRI Publications.

1.04 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Samples for Color Selection: Provide range of available colors for each sealant type as indicated on schedule below.

C. Mock Up. See drawings for requirements of Free Standing Mockup Panel. Provide selected color and types of sealants as applicable.
   1. Provide Mockups in accordance with ASTM C1521.
   2. If Mockup Panel is insufficiently large to show all required sealants, these additional sealants shall be mockuped in place.

D. Joint-Sealant Schedule: Include the following information:
   1. Joint-sealant application, joint location, and designation.
   2. Joint-sealant manufacturer and product name.
   3. Joint-sealant formulation and color.

E. Qualification Data: see Section 01 40 00.

F. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.
   1. Include data for review of non-staining performance.

G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.

H. Preconstruction Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
   1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
   2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

I. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.
   3. See Sections 01 33 00 and 01 60 00.

J. Warranties: Sample of special warranties.

1.05 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

C. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.

D. Product Testing: Test joint sealants using a qualified testing agency.
   1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.

E. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

F. Pre-Installation Conference: Conduct conference at Project site.
   1. Field adhesion testing required. Sealant adhesive testing to all substrates to verify surface preparation, priming, etc. Submit the results of the on-site adhesion testing. (Perform project specific adhesion testing of the joint sealants for all surfaces to receive sealant)

1.06 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.07 WARRANTY

A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
   1. Warranty Period: (From date of Substantial Completion)
      a. Silicone, Urethane and Latex: Two (2) years.
      b. Hybrid Sealants: Ten (10) years.

B. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
   1. Warranty Period: (From date of Substantial Completion)
      a. Silicone, Urethane and Latex: Two (2) years.
      b. Hybrid Sealants: Ten (10) years.

C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
   1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
   2. Disintegration of joint substrates from natural causes exceeding design specifications.
   3. Mechanical damage caused by individuals, tools, or other outside agents.
   4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 PRODUCTS

2.01 MATERIALS, GENERAL

A. Definitions: All terms in this section are defined by ASTM C717.

B. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

C. Liquid-Applied Joint Sealants: Comply with ASTM C920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C920 classifications for type (ASTM C639), grade, class, and uses related to exposure and joint substrates.

D. Stain-Test-Response Characteristics: Where sealants are specified to be non-staining to porous substrates, provide products that have undergone testing according to ASTM C1248and have not stained porous joint substrates indicated for Project.

E. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

F. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range. See Schedule for number of colors.

2.02 HYBRID JOINT SEALANTS (SLNT-1)

A. High performance, Low modulus, High movement, Non-sag, Non-staining, Fast curing, Hybrid Joint Sealant: ASTM C920. Type S, Grade NS, Class 50. ASTM C1382 for use with EIFS wall systems at 100% extension.

1. Products: Subject to compliance with requirements, provide the following:
    a. Dowsil 790, 791, and 795
    b. Dowsil 758 at air barrier substrates.
    c. Or approved substitution.

2.03 SILICONE JOINT SEALANTS

A. Plumbing and Bathroom Sealant **(SLNT-2)** Mildew-Resistant, Single-Component, Acid-Curing Silicone Joint Sealant: ASTM C920, Type S, Grade NS, Class 25, for Use NT.
    1. Products: Subject to compliance with requirements, provide one of the following:
        a. Dow Corning Corporation; 786 Mildew Resistant.
        b. GE Advanced Materials - Silicones; 2* Kitchen and Bath.
        c. Tremco Incorporated; Tremsil 200 Sanitary.
        d. Or approved equal.

B. General Use Interior Sealant **(SLNT-7)** Single Component, General Purpose Acetoxy Cure Silicone Sealant: ASTM C920, Type S, Grade NS, Class 25 for Use NT.
    1. Products: Subject to compliance with requirements, provide one of the following:
        a. Sikasil GP
        b. Tremco, Tremsil 200
        c. Dow Corning Corporation, Dowsil General Purpose Sealant
        d. Or approved equal.

C. Neutral curing, non-staining Silicone Sealant **(SLNT-7A)** for use at masonry. Low modulus, One-part, neutral curing.
    1. Products: Subject to compliance with requirements, provide one of the following:
        a. Tremco Spectrum 3 and Spectrum 4TS,
        b. Pecora 890 NST
        c. Dowsil 991, 688
        d. Or approved equal.

2.04 URETHANE JOINT SEALANTS (SLNT-3)

A. Single-Component, Non-sag, Traffic-Grade, Self Leveling, Polyurethane Joint Sealant: ASTM C920. Type S, Grade NS, Class 25, for Use T.
    1. Products: Subject to compliance with requirements, provide one of the following:
        a. Sika Sikaflex 15LM
        b. Pecora Corporation; Urexpan NR-200.
        c. Tremco Vulkem 45SSL

2.05 LATEX JOINT SEALANTS (SLNT-4)

A. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF.
    1. Products: Subject to compliance with requirements, provide one of the following:
        a. Pecora Corporation; AC-20+.
        b. Tremco Incorporated; Tremflex 834.

2.06 ACOUSTIC JOINT SEALANTS (SLNT-5)

A. Acoustic Sealant for Exposed and Concealed Joints: Manufacturer's standard non-sag, paintable, non-staining latex acoustical sealant complying with ASTM C834.
    1. Products: Subject to compliance with requirements, provide one of the following:
        a. Accumetric, LLC; "BOSS 826 Acoustical Sound Sealant".
        b. Grabber Construction Products; "Acoustical Sealant GSC".
        c. OSI; "SC-175 Acoustic Sound Sealant".

2.07 GLAZING SEALANTS (SLNT-6)

A. Single-Component, Non-sag, Neutral-Curing Silicone Joint Sealant: ASTM C1184, Type S, Grade NS, Class 50, for Use G. Color: As selected by Architect.
    1. Products: Subject to compliance with requirements, provide one of the following:

a. Dow Corning Corporation; 791, 795, 995, or 999-A.
b. GE Advanced Materials - Silicones; SilGlaze II SCS2800, SilPruf NB SCS900,0 SilPruf SCS2000, and UltraPruf II SCS2900.
c. Pecora Corporation; 864.
d. Tremco Incorporated; Spectrem 2 or Spectrem 3.

B. See Section 08 81 00 Glazing.

2.08 SEALANTS FOR EIFS.

A. See Section 07 24 19 Water Drainage Insulation and Finish System.

2.09 JOINT SEALANT BACKING

A. General: Provide sealant backings of material that are non-staining; are compatible with joint substrates, sealants, primers, and other joint fillers as defined by ASTM C719 ; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin) Type O (open-cell material) Type B (bicellular material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable. Provide backer rod sizes approximately 20% in excess of joint width.

2.10 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Non-porous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Non-staining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. Adhesion testing in compliance with Section 1.3 Part E-1 of this section.

3.02 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations

above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
   a. Concrete.
   b. Masonry.
   c. Unglazed surfaces of ceramic tile.
   d. Exterior insulation and finish systems.
3. Remove laitance and form-release agents from concrete.
4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
   a. Metal.
   b. Glass.
   c. Porcelain enamel.
   d. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer including recommended cure times and special instructions/ materials for porous substrates or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.03 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C1193 and for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
   1. Do not leave gaps between ends of sealant backings.
   2. Do not stretch, twist, puncture, or tear sealant backings.
   3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints. Avoid three sided adhesion for all sealant joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
   1. Place sealants so they directly contact and fully wet joint substrates.
   2. Completely fill recesses in each joint configuration.
   3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Non-sag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
   1. Remove excess sealant from surfaces adjacent to joints.
   2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
   3. Provide concave joint profile per Figure 8A in ASTM C1193, unless otherwise indicated.

3.04 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.05 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.06 FIELD ADHESION TESTING (PULL TEST)

A. Extent of Testing: Test completed and cured sealant joints per ASTM C1521 as follows:
   1. Perform a minimum of 10 tests for the first 1000 feet (300 m) of joint length for each type of sealant and joint substrate.
   2. Perform a minimum of 10 tests for the first 1000 feet (300 m) of joint length for each type of sealant and joint substrate.

B. Perform a minimum of 10 tests for the first 1000 feet (300 m) of joint length for each type of sealant and joint substrate.

C. Inspection and Reporting:
   1. Inspect the tested joints for signs of adhesive failure (failure at the bond line) or cohesive failure (the sealant itself tearing).
   2. Record test results in a field adhesion test log. The log shall include test dates, locations, adhesion results, and a comparison to manufacturer's criteria.

D. Remediation: If a sealant fails the adhesion test, remove and replace the deficient sealant application. Retest until results comply with project requirements.

3.07 JOINT-SEALANT SCHEDULE

A. (SLNT-1) Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.
   1. Joint Locations:
      a. Construction joints in cast-in-place concrete.
      b. Joints between precast architectural concrete units.
      c. Control and expansion joints in unit masonry.
      d. Joints in dimension stone cladding.
      e. Joints in glass unit masonry assemblies.
      f. Joints in exterior insulation and finish systems.
      g. Joints between metal panels.
      h. Secondary exterior sealant at joints around windows, storefronts and curtain walls.
      i. Joints between different materials listed above.
      j. Typical at Facade locations.
      k. Air Barrier substrates
      l. Other joints as indicated.
   2. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
      a. Assume (1) color for each material transition. (eg: Brick to Metal panel, EIFS to Quarried stone, etc)

B. (SLNT-2) Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.
   1. Joint Sealant Location:
      a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
      b. Joints around toilet accessories.
      c. Joints between mirrors and adjacent material.

d. Joints at countertops to walls.
e. Tile control and expansion joints where indicated.
f. Around access panels and penetrations in natatorium, locker rooms, toilet rooms, pump rooms, and any other room where moisture will be present.
g. At interior IFS, as required by specification 07 24 20.
h. Joints at kitchen equipment, fixtures and stainless steel shelvings to walls and counters.
i. Other joints as indicated.

2. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors, Clear, White.

C. (SLNT-3) Joint-Sealant Application: Interior joints in horizontal traffic surfaces.
1. Joint Locations:
a. Isolation joints in cast-in-place concrete slabs.
b. Control and expansion joints in stone flooring.
c. Control and expansion joints in tile flooring.
d. Other joints as indicated.
2. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
a. Assume (1) color for each material transition. (eg: Tile to concrete, each tile color, etc)

D. (SLNT-4) Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.
1. Joint Locations:
a. Control and expansion joints on exposed interior surfaces of exterior walls.
b. Perimeter joints of exterior openings where indicated.
c. Tile control and expansion joints.
d. Vertical joints on exposed surfaces of interior unit masonry concrete walls and partitions.
e. Joints between stone or tile and wall coverings.
f. Joints around access panels and fire extinguisher cabinets in dry locations. (where panels are located in a wet area, such as a locker room, natatorium, wet spa, kitchen, bathroom, etc, use SLNT-2 above)
g. Perimeter joints between interior wall surfaces and frames of interior doors, windows and elevator entrances.
h. Other joints as indicated.
2. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
a. Assume (1) color for each material transition. (eg: Metal Frame to wall, each tile color, etc)

E. (SLNT-5) Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces at Acoustical Separation Walls.
1. Joint Locations:
a. Control and expansion joints on exposed interior surfaces of exterior walls.
b. Perimeter joints of exterior openings where indicated.
c. Tile control and expansion joints.
d. Vertical joints on exposed surfaces of interior unit masonry concrete walls and partitions.
e. Joints on underside of plant-precast structural concrete beams and planks.
f. Perimeter joints between interior wall surfaces and frames of interior doors windows and elevator entrances.
g. Other joints as indicated.
2. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
a. Assume (1) color for each material transition. (eg: Metal Frame to wall, each tile color, etc)

F. (SLNT-6) Glazing Sealant Application: Apply according to ASTM C1401. See Section 08 81 00.
1. Joint Locations:
a. Around Glazing, according to ASTM C1401.
b. Perimeter joints between materials listed above and frames of doors, windows and louvers (Primary Seal).

G. (SLNT-7) General Use Interior Sealant: Use at interior joints between dissimilar materials where no other above sealant applies:
   1. Joint Locations:
      a. Between casework and walls. (where casework is located in a wet area, such as a locker room, natatorium, wet spa, kitchen, bathroom, etc, use SLNT-2 above)
      b. Between wall covering and bases or ceilings where edges of wall covering would otherwise be exposed.
      c. Around mirrors in exercise areas and studios. See SLNT-2 above for other mirrors.
      d. Between stone countertops, benchtops, sills etc and casework and walls.
      e. Where aesthetic sealants are indicated on drawings.
   2. Joint-Sealant Color: Clear, typ.

H. See Section 13 11 15 for Sealants around Swimming Pools.

END OF SECTION

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SECTION 07 95 00
PREFORMED TRAFFIC DURABLE SEALANT SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. Preformed traffic durable sealant systems and accessories.

1.02 RELATED WORK

A. Section 01 33 00 - Submittal Procedures.

B. Section 01 40 00 - Quality Requirements.

C. Section 01 60 00 - Product Requirements.

D. Section 03 41 00 - Precast Structural Concrete.

E. Section 07 92 00 - Joint Sealants.

F. Section 32 13 13 - Concrete Paving.

G. Section 32 14 00 - Unit Paving.

1.03 REFERENCES

A. ASTM C881: Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete

B. ASTM D545: Standard Test Methods for Preformed Expansion Joint Fillers for Concrete Construction (Nonextruding and Resilient Types)

C. ASTM D624: Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers

D. ASTM D3575: Standard Test Methods for Flexible Cellular Materials Made From Olefin Polymers.

E. AASHTO T42: Standard Method of Test for Preformed Expansion Joint Filler for Concrete Construction

1.04 SUBMITTALS

A. General - Submit the following according to Section 01 33 00 - Submittal Procedures.

B. Product information and independent lab test results.

C. Shop Drawing - Submit typical expansion joint drawing(s) indicating pertinent dimensions, general construction, corners, expansion joint opening dimensions.

D. Material sample and color selector.

E. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.
   3. See Sections 01 33 00 and 01 60 00.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver and store all products according to Manufacturer's recommendations. Allow product to equalize with ambient temperature prior to installation.

1.06 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Installer's qualifications. Installer must be ISO-9001 certified and approved by product manufacturer.

PART 2 PRODUCT

2.01 MANUFACTURERS

A. General: Provide traffic durable, watertight, UV stable expansion joint for isolation joints in concrete structures and paving.

1. Typical locations include, but are not limited to the following: joints over occupied space, below-grade, stair tower perimeters, elevator perimeters, curbs, parking deck joints, and structural expansion joints.
2. System shall perform waterproofing, traffic bearing and movement-accommodation functions as the result of a single installation and without the addition of gutters, vapor barriers, bladders, or other devices suspended beneath or within the system in any way.
3. System shall be heat stable for a range of -40F to 150F without any bleeding of material. Material shall be capable of expansion after being subjected to extreme temperatures.

B. Traffic Sealant: Low density, closed cell, cross linked polymer joint seal. Acceptable Manufacturers and products:
1. **TSLNT-1**: Precompressed silicone and impregnated foam seal bonded with epoxy adhesive.
a. Emseal, DSM
b. Or approved substitution.
2. **TSLNT-2**: Low density closed cell joint seal bonded with expoxy adhesive:
a. Watson, Bowman, Acme, Wabo Evazote UV
b. Or approved substitution.
3. Color: To be selected by Architect from Manufacturer's full range.

2.02 ACCESSORIES

A. Adhesive as supplied by product manufacturer.

B. Provide Factory-manufacturered bends for directional changes. Butting two non-bended units together at corners is not acceptable.

PART 3 EXECUTION

3.01 INSTALLATION

A. Preparation of the Work Area:
1. Verify that joint opening matches the manufacturer's recommended range for selected product. Report discrepencies to Architect/Engineer and adjust sealant sizes as directed.
2. Clean joint opening of all contaminants before installation.
3. Repair spalled, irregular or unsound joint surfaces using accepted industry practices. Smooth sides to meet Manufacturer's installation standards.
4. Verify all surfaces meet Manufacturer's requirements to the full depth of the installation.

B. Installation of Product:
1. Use only Manufacturer's adhesive.
2. Do not install if temperature, humidity or weather are outside the range recommended by Manufacturer.
3. Do not drill, screw or use fasteners of any type.
4. Install so that the finished product is flush with the traffic surface.
5. Precompress joint material to size smaller than joint prior to installation.
6. Conform to all Manufacturer's instructions.

3.02 CLEAN AND PROTECT

A. Protect the system and its components during construction.

B. After work is complete, clean exposed surfaces with a suitable cleaner that will not harm or attack the finish.

END OF SECTION

SECTION 08 08 00
COMMISSIONING OF OPENINGS

PART 1 GENERAL

1.01 SUMMARY

A. This section includes specific requirements that apply to the implementation of the Commissioning Process and this Division Contractors' participation in this process. This section details the project specific equipment and systems that are included in the Commissioning Process. For general descriptions and responsibilities, refer to SECTION 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

1.02 RELATED DOCUMENTS

A. The Owner's Project Requirements (OPR) document.

B. The Basis of Design (BoD) document.

C. The Project Commissioning Plan (CxP) document.

D. ASHRAE Standard 202-2013 - Commissioning Process for Buildings and Systems.

1.03 RELATED SECTIONS

A. SECTION 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS

B. SECTION 07 08 00 - COMMISSIONING OF THERMAL AND MOISTURE PROTECTION

C. SECTION 11 08 00 - COMMISSIONING OF EQUIPMENT

D. SECTION 13 08 00 - COMMISSIONING OF SPECIAL CONSTRUCTION

E. SECTION 14 08 00 - COMMISSIONING OF CONVEYING SYSTEMS

F. SECTION 21 08 00 - COMMISSIONING OF FIRE SUPPRESSION SYSTEMS

G. SECTION 22 08 00 - COMMISSIONING OF PLUMBING SYSTEMS

H. SECTION 23 08 00 - COMMISSIONING OF MECHANICAL SYSTEMS

I. SECTION 25 08 00 - COMMISSIONING OF INTEGRATED AUTOMATION SYSTEMS

J. SECTION 26 08 00 - COMMISSIONING OF ELECTRICAL SYSTEMS

K. SECTION 27 08 00 - COMMISSIONING OF COMMUNICATIONS SYSTEMS

L. SECTION 28 08 00 - COMMISSIONING OF SAFETY AND SECURITY SYSTEMS

M. SECTION 33 08 00 - COMMISSIONING OF UTILITIES

1.04 DEFINITIONS

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

1.05 RESPONSIBILITIES

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

PART 2 PRODUCTS

2.01 NO PRODUCTS SUPPLIED

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

B. Contractors and/or Vendors shall provide the specialty testing equipment necessary to fulfill the functional testing requirements, for the duration of the testing period.

PART 3 EXECUTION

3.01 GENERAL

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.02 MEETINGS

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.03 SYSTEM START-UP

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.04 PRE-FUNCTIONAL CHECKLISTS

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.05 FUNCTIONAL PERFORMANCE TESTING

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.06 TRAINING

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.07 SYSTEMS TO BE COMMISSIONED

A. GENERAL
   1. Commissioning specifications supplement the requirements of individual specifications sections, but shall not be interpreted to replace or diminish the specified scope of any individual section.
   2. For all systems listed below, Division Contractor shall comply with all commissioning requirements specified.

B. APPLICABLE SYSTEMS
   1. Hollow Metal Doors and Frames
   2. Aluminum Framed Entrances and Storefronts
   3. Glazed Aluminum Curtainwalls
   4. Door Hardware
   5. Automatic Door Operators
   6. Glazing

END OF SECTION

SECTION 08 11 13
HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Non-rated and fire rated steel doors.
   2. Non-rated and fire rated steel frames.
   3. Accessories:
      a. Glazing stops.
      b. Louvers.
      c. Astragals.
      d. Misc Accessories.

1.02 RELATED SECTIONS

A. Section 01 33 00 - Submittal Procedures.

B. Section 01 40 00 - Quality Requirements.

C. Section 01 60 00 - Product Requirements

D. Section 04 20 00 - Unit Masonry.

E. Section 06 10 00 - Rough Carpentry.

F. Section 06 20 00 - Finish Carpentry.

G. Section 07 92 00 - Joint Sealants.

H. Section 08 08 00 - Commissioning of Openings.

I. Section 08 14 16 - Flush Wood Doors.

J. Section 08 41 13 - Aluminum Entrances and Storefronts

K. Section 08 71 00 - Door Hardware.

L. Section 08 81 00 - Glazing.

1.03 REFERENCE STANDARDS

A. ANSI A117.1 - Specifications for Making Buildings and Facilities Accessible to and Useable by Physically Handicapped People.; 2009.

B. ANSI/DHI A115 - Wood Door Hardware Standards: Hardware Preparation; Current Edition, Including All Revisions.

C. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames; 2024.

D. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2023.

E. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2020.

F. ANSI/SDI A250.11 - Recommended Erection Instructions for Steel Frames; 2022.

G. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

H. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2023, with Editorial Revision.

I. ASTM C1364 - Standard Specification for Architectural Cast Stone; 2023.

J. DHI (LOCS) - Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames; 2004.

K. ICC A117.1-2009 - Accessible and Usable Buildings and Facilities; 2009.

L. ITS (DIR) - Directory of Listed Products; Current Edition.

M. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2025.

N. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives; 2025.

O. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2022.

P. SDI 111 - Recommended Details for Standard Steel Doors, Frames, and Accessories; 2024.

Q. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames; 2023.

R. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Pre-Submittal Hardware and Keying Meeting: Prior to preparing final submittals, conduct meeting including Owner, Architect, and supplier of hardware to determine the following:
   1. Lock Function: Demonstrate function/type of each lockset scheduled and verify function at each door.
   2. Electrical Operation: Verify function of openings requiring electrified hardware.
   3. Keying: Determine keying requirements for preparation of final keying schedule.
   4. Submit letter of compliance, indicating when this meeting was held and who was in attendance, to Architect, Owner, and hardware supplier.

1.05 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Provide doors and frames complying with Steel Door Institute "Recommended Specifications Standard Steel Doors and Frames" ANSI/SDI A250.8, SDI 111, SDI 117 and as herein specified.

C. Fire rated door and frame construction to conform to NFPA 252.

D. Installed frame and door assembly to conform to NFPA 80 for fire rated class indicated in Schedule.

1.06 REGULATORY REQUIREMENTS

A. Conform to applicable code for fire rated frames and doors.
   1. Where fire rated doors are indicated on the Door Schedule, doors shall comply with the requirements of UL 10C for positive pressure requirements. Door assemblies shall bear a fire-rating label issued by a listing agency showing the hourly fire rating followed by the letter “S”.

B. All doors to conform to Accessibility Standards of ICC A117.1-2009.

1.07 SUBMITTALS

A. Material and Equipment Submittals: Submit the following under provisions of Section 01 33 00-Submittal Requirements.
   1. Shop Drawings:
      a. Provide schedule of doors and frames using same opening numbers referenced on the drawings.
      b. Indicate frame gage and configuration, fire label, anchor types and spacing, location of cutouts for hardware, and reinforcement.
      c. Indicate door elevations, hardware group, core material, internal reinforcement, closure method, and cut outs for glazing and louvers.
      d. Include details of connection to surrounding air/ water barrier.
   2. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes.
   3. Procurement:
      a. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.

b. Submit inventory to Owner within 5 days of delivery of materials.
c. See Sections 01 33 00 and 01 60 00.

1.08 DELIVERY, STORAGE AND PROTECTION

A. Protect products under provisions of Section 01 60 00 - Product Requirements.
1. Protect doors and frames with resilient packaging sealed with heat shrunk plastic.
2. Break seal on-site to permit ventilation.

1.09 WARRANTY

A. See Section 01 77 00 - Closeout Procedures for additional warranty requirements.

B. Correct defective Work within a five year period after Date of Substantial Completion.

C. Provide ten year manufacturer warranty for defects in workmanship and materials.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide products from 1 of the following:
1. Amweld Building Products, Inc.
2. Ceco Corporation.
3. Curries Mfg., Inc.
4. Republic Builders Products Corp.
5. Steelcraft Mfg. Co.
6. Approved substitution from SDI Member as approved by the Architect.

2.02 STEEL DOORS

A. Exterior Doors: ANSI/SDI A250.8 Level 3, Model 2; minimum 16 gage zinc-iron alloy-coated Galvannealed steel sheet faces complying with ASTM A653/A653M A60 seamless, composite construction; polystyrene or polyurethane foam core bonded to the inside of both faces. Exterior doors shall have a minimum operable "U" value of 0.77 meeting requirements of ASTM C1363.

B. Interior Non-Fire-Rated Doors: ANSI/SDI A250.8 Level 2, Model 2; minimum 18 gage cold rolled steel sheet complying with ASTM A1008/A1008M seamless, composite construction; honeycomb core laminated to the inside of both face sheets.

C. Interior Fire-Rated Stairwell Doors: ANSI/SDI A250.8 Level 2, Model 2; minimum 18 gage cold rolled steel sheet complying with ASTM A1008/A1008M; seamless, composite construction; temperature rise door.
1. Provide interior fire-rated doors with UL label as indicated on Room Opening Schedule.

D. Interior Fire-Rated Doors: ANSI/SDI A250.8 Level 2, Model 2; minimum 18 gage cold rolled steel sheet complying with ASTM A1008/A1008M; seamless, composite construction; temperature rise door with mineral fiber core.
1. Provide interior fire-rated doors with UL label as indicated on Room Opening Schedule.

2.03 STEEL FRAMES

A. General: Comply with ANSI/SDI A250.8.

B. Exterior Frames: Metallic-coated steel sheet, minimum 14 gauge, ASTM A653/A653M, Commercial Steel (CS), Type B; with minimum A60 (Z180) zinc-iron alloy-coated Galvannealed coating. Frame profiles shall include a thermal barrier at the frame soffit providing a positive thermal break within the frame profile.

C. Interior Frames: Cold-rolled steel sheet, minimum 16 gauge ASTM A1008/A1008M, CS, Type B; suitable for exposed applications.

D. Interior frames in high humidity, moisture areas (Locker rooms, shower areas, pool areas ect.): Metallic-coated steel sheet, minimum 14 gauge, ASTM A653/A653M, Commercial Steel (CS), Type B; with minimum A60 (Z180) zinc-iron alloy-coated Galvannealed coating.

E. Hardware Reinforcement: Fabricate per ANSI/SDI A250.6 with reinforcement plates from same material as frames.

2.04 ACCESSORIES

A. Glazing Stops: Rolled steel channel shape, mitered or butted corners; prepared for countersink style tamperproof screws.

B. Louvers: Manufacturer's standard roll formed steel material, wiped coat of zinc; inverted 'Y' blade, sight proof; standard frame with surface tamperproof fasteners; prime painted finish.

C. Astragals: Provide “Z” style astragals at pairs of doors as required by hardware application. Flat bar astragals are not allowed.

D. Grout Guards: Formed from same material as frames, not less than 0.016 inch (0.4 mm) thick.

E. Rubber Silencers: Resilient rubber.

F. Sill Pan W/ Back Dams: Pemko 2008 PK.

2.05 FABRICATION

A. Tolerances: Fabricate hollow metal Work to tolerances indicated in SDI 117.

B. Fabricate frames with saw miter or saw butt end corner construction. Joints are to be die-mitered with integral tabs for reinforcement and interlocking of the jambs to the head. Grind exposed welds and surfaces smooth with no joints visible anywhere on the face of frame.

C. Provide frames of required throat depth for wall thickness.

D. Hardware Preparation: Factory prepare hollow metal Work to receive templated mortised hardware per Door Hardware Schedule and templates furnished as specified in Section 08 71 00 - Door Hardware.
   1. Locate hardware as indicated, or if not indicated, per ANSI/SDI A250.8 and DHI (LOCS).
   2. Reinforce doors and frames to receive non-templated, mortised and surface-mounted door hardware.
   3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal Work for hardware.
   4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 16 electrical Sections.

E. Where grouting or mortar filled frames and frames in high humidity, moisture areas (Locker rooms, shower areas, pool areas etc.) are specified, or where antifreeze additive are used in fill, protect inside throat of each frame with a waterproof undercoating type material, minimum 1/8 inch thick.

F. Fabricate doors without seams on faces or vertical edges of door. Continuously weld vertical edge seams, and grind smooth.

G. Reinforce frames wider than 48" with roll formed steel channels fitted tightly into frame head, flush with top.

H. Prepare frame for silencers. Provide three single rubber silencers on strike jamb for single doors, two single rubber silencers on strike jamb of ½ height doors and two single silencers on frame head at double doors.

I. Attach metal fire rated label to each frame and door unit, where required.

J. Reinforce top and bottom edges with a 14 gauge channel welded to face sheets.

K. Close top edge of exterior door flush with inverted 16 gauge steel channel closure. Seal joints watertight.

L. Provide fixed glazing stops on outside of exterior doors and on secure side of interior doors.

M. Provide screw-applied, removable glazing beads on inside of glass, louvers and other panels in doors.

N. Provide shipping separation panel for all exterior door frames with ½” plywood spacer panel, two feet high by width of frame to maintain integrity of frame width during shipping and installation.

2.06 STEEL FINISHES

A. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating. Apply primer uniformly inside and outside of frame, and under removable stops and trim.
   1. Shop Primer: ANSI/SDI A250.10.
   2. Final Finish: Refer to door schedule, submit all finishes to architect for approval.

PART 3 EXECUTION

3.01 INSTALLATION

A. General: Install hollow metal Work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11.
   1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
      a. At fire-protection-rated openings, install frames per NFPA 80.

C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.
   1. Non-Fire-Rated Standard Steel Doors:
      a. Jambs and Head: 1/8 inch (3 mm) plus or minus 1/16 inch (1.6 mm).
      b. Between Edges of Pairs of Doors: 1/8 inch (3 mm) plus or minus 1/16 inch (1.6 mm).
      c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch (10 mm).
      d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch (19 mm).
   2. Fire-Rated Doors: Install doors with clearances per NFPA 80.
   3. Smoke-Control Doors: Install doors per NFPA 105.

D. Glazing: Comply with requirements in Section 08 81 00 - Glass Glazing and with hollow metal manufacturer's written instructions.
   1. Glaze doors at factory or in supplier shop with glass of type and thickness indicated on Drawings. Coordinate with Section 08 81 00 for glass types. Install glass as recommended by manufacturer and in compliance with ITS (DIR) - Warnock Hersey or UL approved glazing system.
   2. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (229 mm) on center and not more than 2 inches (51 mm) on center from each corner.

E. Coordinate with masonry and wallboard wall construction for anchor placement.
   1. Masonry Construction: Install frames up to 60" high in masonry construction with minimum 2 jamb anchors each jamb; add an additional anchor for every 30" or fraction thereof.
   2. Wallboard Construction: Install frames up to 60" high in wallboard construction with minimum 3 jamb anchors each jamb; add an additional anchor for every 24" or fraction thereof.

F. Coordinate installation of glass and glazing.

3.02 TOLERANCES

A. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
   1. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
   2. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
   3. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
   4. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.

3.03 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave Work in complete and proper operating condition. Remove and replace defective Work, including hollow metal Work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow metal Work immediately after installation.

C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

END OF SECTION

SECTION 08 14 16
FLUSH WOOD DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wood doors.

B. Rated wood doors.

C. Pre-fitting and pre-machining for hardware.

D. Factory pre-finishing wood doors.

1.02 RELATED SECTIONS

A. Section 01 33 00 - Submittal Procedures.

B. Section 01 40 00 - Quality Requirements.

C. Section 01 60 00 - Product Requirements.

D. Section 04 20 00 - Unit Masonry.

E. Section 06 10 00 - Rough Carpentry.

F. Section 06 20 00 - Finish Carpentry.

G. Section 08 71 00 - Door Hardware.

H. Section 08 81 00 - Glazing.

1.03 REFERENCE STANDARDS

A. ANSI A135.4 American National Standard for Basic Hardboard.

B. ASTM D1037 - Standard Test Methods for Evaluating Properties of Wood-Base Fiber and Particle Panel Materials; 2012 (Reapproved 2020).

C. AWI (AWS) - Architectural Woodwork Standards; 2014, with Errata (2016).

D. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2025.

E. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2022.

F. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

G. WDMA I.S. 1A - Interior Architectural Wood Flush Doors; 2021, with Errata (2022).

H. ASTM E84 Standard Test Method for Surface Burning.

I. AWI (QCP) American Wood Institute Quality Certification Program.

J. AWI/AWMAC/WI (AWS) American Wood Institute Architectural Wood Standards.

K. AWMAC (GIS) Architectural Woodwork Standards.

L. AWMAC/WI (NAAWS) North American Architectural Woodwork Standards.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Pre-Submittal Hardware and Keying Meeting: Prior to preparing final submittals, conduct meeting including Owner, Architect, and supplier of hardware to determine the following:
   1. Lock Function: Demonstrate function/type of each lockset scheduled and verify function at each door.
   2. Electrical Operation: Verify function of openings requiring electrified hardware.
   3. Keying: Determine keying requirements for preparation of final keying schedule.
   4. Submit letter of compliance, indicating when this meeting was held and who was in attendance, to Architect, Owner, and hardware supplier.

1.05 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Source Limitations: Obtain flush wood doors from single manufacturer.

C. Quality Standard: In addition to requirements specified, comply with WDMA I.S. 1A, "Architectural Wood Flush Doors. AWI (AWS) "Architectural Woodwork Quality Standards Illustrated."

D. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure per NFPA 252 or UL 10C.
   1. Temperature-Rise Limit: Where indicated, provide doors that have a maximum transmitted temperature end point of not more than 450 degrees F (250 degrees C) above ambient after 30 minutes of standard fire-test exposure.

E. Factory Finishing of Doors: Arrange with Owner to remove at least 1 existing wood door for the purpose of storing at wood door factory as a basis for matching existing stain and finish. Select appropriate door with Architect's direction.

1.06 REGULATORY REQUIREMENTS

A. Conform to applicable code for fire rated doors.

B. Furnish manufacturer's appropriate listed door to maintain rated assembly, including compatibility with specified hardware.

C. Where fire rated doors are indicated on the Door Schedule, doors shall comply with the requirements of UL 10C for positive pressure requirements. Door assemblies shall bear a fire-rating label issued by a listing agency showing the hourly fire rating followed by the letter "S".

1.07 SUBMITTALS

A. Material and Equipment Submittals: Submit the following under provisions of Section 01 30 00- Submittals:
   1. Shop Drawings: Indicate elevations for each door type, location, size, fire ratings, swing, undercuts, stile and rail reinforcement, internal blocking for hardware attachment, and cutouts for glazing and louvers.
   2. Product Data: Submit product data for each type of door specified.
   3. Samples: Submit four (4) 12" x 12" samples of factory finishing for approval.

B. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.
   3. See Sections 01 33 00 and 01 60 00.

C. Closeout Submittals: Submit the following under provisions of Section 01 77 00 - Contract Closeout.
   1. Warranty.
   2. Operation and Maintenance information.

1.08 DELIVERY, STORAGE, AND PROTECTION

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Package doors individually in cardboard cartons and wrap bundles of doors in plastic sheeting.
   1. Stack wood doors as recommended by door manufacturer.
   2. Use opaque plastic sheeting for natural finished doors.

C. Mark each door on top and bottom with a label from the manufacturer indicating the following: Opening number used on Shop Drawings, door construction, face veneer species, cut and grade. If factory finished, include finishing information.

D. Do not deliver doors until building is enclosed, warm, dry, and at design humidity levels, and painting Subcontractors are on Project site ready to apply finish immediately after delivery.

1.09 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet Work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during remainder of construction period.

1.10 WARRANTY

A. Warranty: Provide written warranty signed by door manufacturer, installer and Contractor agreeing to replace defective doors. Door defects include, but are not limited to the following:
   1. Delamination in any degree.
   2. Warp or twist of 1/4" or more in any door panel.
   3. Telegraphing of any part of core assembly through face veneer to cause surface variation of 1/100" or more in a 3" span.
   4. Other defects which affect performance of door.

B. Warranty shall cover the cost of refinishing, installation of hardware and re-hanging defective doors. Warranty shall be in effect for the following time periods:
   1. Interior Solid Core Doors: For the life of the installation.

PART 2 PRODUCTS

2.01 FLUSH SOLID CORE INTERIOR WOOD DOORS

A. Flush 5-ply door construction with solid particle core, urea-formaldehyde free bonded to stiles and rails using Type 1 waterproof glue.
   1. Quality Grade: AWI Premium.
   2. Door Thickness: 1-3/4” thick.
   3. Acceptable Manufacturers:
      a. Oshkosh Architectural Door Company.
      b. Masonite Architectural.
      c. VT Industries.

B. Non-Rated Doors:
   1. Quality Type: AWI Type PC-5.
   2. Stiles: 2-ply, 1-1/4” thick after trimming laminated stiles. Outer ply 1/4" hardwood to match veneer face; inner ply 1-1/8 “mill option hardwood or softwood.
   3. Rails: 1-1/8" thick mill option hardwood or softwood. Thicker as required for hardware concealed fastener.
   4. Acceptable Products:
      a. Masonite Architectural "Aspiro."
      b. VT "Heritage Collection."
      c. Oshkosh “GP5V”.

C. 20 Minute Doors:
   1. Quality Type: AWI Type FD 1/3; and complying to UL10C positive pressure requirements.
   2. Stiles: 2-ply, minimum 5-1/2" thick laminated stiles after trimming. Outer ply 3/4" hardwood to match veneer face; inner ply mill option hardwood or softwood.
   3. Top Rail: Minimum 5-1/2" thick mill option lumber.
   4. Acceptable Products:
      a. Masonite Architectural "Aspiro," 20 Minute.
      b. VT "Heritage Collection," 20 Minute.
      c. Oshkosh “GP5V”, 20 Minute.

D. 3/4 and 1-1/2 Hour Doors:
   1. Quality Type: AWI Type FD 3/4 or Type FD 1 as indicated on Door Schedule; and complying to UL10C positive pressure requirements with intumescent seals concealed by outer stile (Category A).

2. Stiles: Provide wood door manufacturer's standard laminated edge construction capable of withstanding a minimum of 740 pounds of pull per screw when tested in accordance with ASTM D1037.
3. Top Rail: 5-1/2” minimum thick mill option lumber.
4. Bottom Rail: 1-1/8" thick mill option hardwood or softwood.
5. Internal Reinforcement:
    1) Lock Blocks: 5-1/2" x 12" minimum mill option lumber. Provide two blocks for doors scheduled to receive exit devices.
    2) Flush Bolts: Provide 5-1/2" x 12" lumber reinforcement at flush bolt locations.
6. Acceptable Products:
    a. Masonite Architectural "Aspiro," 45 and 60 Minute.
    b. VT "Heritage Collection," 45 and 60 Minute.
    c. Oshkosh “GF5V”, 45 and 60 Minute.

2.02 FACE VENEER

A. Veneer: AWI Grade A, 1/50" thick minimum veneer thickness prior to sanding.
1. Species: Walnut, stain to match PLAM-34. See Door Schedule and Section 06 40 00 – Architectural Woodwork.
2. Cut: Plain sliced (Flat Cut).
3. Matching between Individual Pieces of Veneer: Book match.
4. Assembly of Spliced Veneer on Face: Balance match (5 pieces maximum).

2.03 ACCESSORIES

A. Glass Stops: Square, beveled, to be provided by door manufacturer to match door species and finish and provide required fire rating.

2.04 FABRICATION

A. Fabricate non-rated doors in accordance with AWI Quality Standards requirements.

B. Fabricate fire rated doors in accordance with AWI Quality Standards and UL requirements. Permanently attach UL fire rating label to door edge of all fire rated doors. Provide S-Label where indicated on Door Schedule.

C. Provide non-rated and 20 minute rated flush doors with 1-3/8" thick minimum, 2-ply edge bands, with outer ply 1/2" thick minimum edge strips of wood species to match face veneer or as otherwise required to comply with UBC

D. Provide fire rated doors with ratings greater than 20 minute with manufacturer's laminated edge construction to provide specified screw holding capability.

E. Provide minimum 5” top blocking, sill blocking and lock block on all doors. Provide 10” high intermediate blocking on all doors when exit devices are specified.

F. Pre-fit and pre-machine doors for finish hardware, except for hardware items considered to be surface mounted, as specified in Section 08 71 00. Comply with AWI Section 01 30 00 for factory pre-fitting and pre-machining.

G. Bevel strike edge of double doors 1/8” in 2”. Radius strike edge of double acting swing doors.

H. Seal cutouts prior to installation of moldings or stops.

2.05 FACTORY FINISHING

A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
1. Finish faces, all 4 edges, edges of cutouts, and mortises. Stains and fillers may be omitted on bottom edges, edges of cutouts, and mortises.

B. Finish doors at factory that are indicated to receive transparent finish. Field finish doors indicated to receive opaque finish.

C. Transparent Finish:
1. Grade: Premium.

2. Finish: AWI conversion varnish catalyzed polyurethane system.
3. Staining: Custom match to millwork. Contact LT to obtain control sample. Provide stain match samples to architect for approval.
4. Sheen: Satin.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine doors and installed door frames before hanging doors.
   1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
   2. Reject doors with defects.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Hardware: For installation, see Section 08 71 00 - Door Hardware.

B. Installation Instructions: Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.
   1. Install fire-rated doors in corresponding fire-rated frames per NFPA 80.

C. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
   1. Clearances: Provide 1/8 inch (3.2 mm) at heads, jambs, and between pairs of doors. Provide 3/4 inch (18 mm) from bottom of door to top of decorative floor finish or covering unless otherwise indicated. Where threshold is shown or scheduled, provide 1/4 inch (6.4 mm) from bottom of door to top of threshold unless otherwise indicated.
      a. Comply with NFPA 80 for fire-rated doors.
   2. Bevel non-fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) at lock and hinge edges.
   3. Bevel fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) at lock edge; trim stiles and rails only to extent permitted by labeling agency.

D. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

E. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.03 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely. If door cannot be made to operate properly, remove and install new door.

B. Protect doors as recommended by door manufacturer to ensure that wood doors are without damage or deterioration at the time of Substantial Completion.
   1. Remove doors damaged during installation and install new doors.

C. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.
   1. Restore finish before installation, if fitting or machining is required at Project site.

END OF SECTION

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SECTION 08 31 13
ACCESS DOORS AND FRAMES

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes the following:
   1. Access doors and frames for walls and ceilings.

1.02 RELATED SECTIONS

A. Section 01 33 00 - Submittal Procedures.

B. Section 01 40 00 - Quality Requirements.

C. Section 01 60 00 - Product Requirements.

D. Section 06 10 00 - Rough Carpentry.

E. Section 06 20 00 - Finish Carpentry.

F. Section 06 64 00 - Plastic Paneling.

G. Section 08 71 00 - Door Hardware.

H. Section 09 21 16 - Gypsum Board Assemblies.

I. Section 09 30 00 - Tiling.

J. Section 09 91 00 - Painting.

K. Div 21 - Fire Suppression.

L. Div 22 - Plumbing.

M. Div 23 - HVAC.

N. Div 25 - Automation.

O. Div 26 - Electrical.

P. Div 27 - Communications.

1.03 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.

D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

E. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2020.

F. ASTM A924/A924M - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process; 2022a.

G. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2023, with Editorial Revision.

H. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.

I. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).

J. SSPC-SP 5 - White Metal Blast Cleaning; 2007.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Pre-Submittal Hardware and Keying Meeting: Prior to preparing final submittals, conduct meeting including Owner, Architect, and supplier of hardware to determine the following:
   1. Keying: Determine keying requirements for preparation of final keying schedule.
   2. Submit letter of compliance, indicating when this meeting was held and who was in attendance, to Architect, Owner, and hardware supplier.

1.05 SUBMITTALS

A. Product Data: For each type of access door and frame indicated. Include construction details, materials, individual components and profiles, and finishes.

B. Shop Drawings: Show fabrication and installation details of access doors and frames for each type of substrate. Include plans, elevations, sections, details, and attachments to other work.

C. Access Door and Frame Schedule: Provide complete access door and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.

D. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.
   3. See Sections 01 33 00 and 01 60 00.

1.06 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Source Limitations: Obtain access door(s) and frame(s) through one source from a single manufacturer.

C. Size Variations: Obtain Architect's acceptance of manufacturer's standard-size units, which may vary slightly from sizes indicated.

1.07 COORDINATION

A. Verification: Determine specific locations and sizes for access doors needed to gain access to concealed plumbing, mechanical, or other concealed work, and indicate in the schedule specified in "Submittals" Article.

PART 2 PRODUCTS

2.01 STEEL MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
   1. ASTM A123/A123M, for galvanizing steel and iron products.
   2. ASTM A153/A153M, for galvanizing steel and iron hardware.

B. Steel Sheet: Uncoated cold-rolled steel sheet substrate complying with ASTM A1008/A1008M, Commercial Steel (CS), exposed.

C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS) with A60 (ZF180) zinc-iron-alloy (galvannealed) coating or G60 (Z180) mill-phosphatized zinc coating; stretcher-leveled standard of flatness; with minimum thickness indicated representing specified thickness according to ASTM A924/A924M.

D. Steel Finishes: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
   1. Surface Preparation for Steel Sheet: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5 /NACE No. 1, "White Metal Blast Cleaning", or SSPC-SP 8, "Pickling".
   2. Surface Preparation for Metallic-Coated Steel Sheet: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and

abraded areas, and apply galvanizing repair paint specified below to comply with ASTM A780/A780M.

a. Galvanizing Repair Paint: High-zinc-dust-content paint for re-galvanizing welds in steel, complying with SSPC-Paint 20.

2.02 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Acudor Products, Inc.
   2. Babcock-Davis.
   3. Cendrex Inc.
   4. Cesco.
   5. Dur-Red Products.
   6. Elmdor/Stoneman.
   7. Karp Associates, Inc.
   8. Larsen's Manufacturing Company.
   9. MIFAB, Inc.
   10. Milcor Inc.
   11. Nystrom, Inc.
   12. Williams Bros. Corporation of America (The).

B. Recessed Access Door / Drywall Panel Door.
   1. Locations: Wall and ceiling surfaces, see plans and elevations.
   2. Door: Minimum 0.060 inch (1.5 mm) thick sheet metal.
   3. Frame: Minimum 0.060 inch (1.5-mm) thick sheet metal with 1-1/4 inch (32-mm) wide, recessed trim.
   4. Hinges: Continuous piano.
   5. Lock: Cylinder.
      a. Lock Preparation: Section 08 71 00 - Door Hardware.

C. Flush Access Doors and Frames with Exposed Trim: Fabricated from steel sheet.
   1. Locations: Wall and ceiling surfaces.
   2. Door: Minimum 0.060 inch (1.5 mm) thick sheet metal.
   3. Frame: Minimum 0.060 inch (1.5-mm) thick sheet metal with 1-1/4 inch (32-mm) wide, surface-mounted trim.
   4. Hinges: Continuous piano.
   5. Lock: Cylinder.
      a. Lock Preparation: Section 08 71 00 - Door Hardware.

D. Fire-Rated, Insulated, Flush Access Doors and Frames with Exposed Trim: Fabricated from steel sheet.
   1. Locations: Wall and ceiling surfaces.
   2. Fire-Resistance Rating: Not less than that of adjacent construction.
   3. Temperature Rise Rating: 250 degrees F (139 degrees C) at the end of 30 minutes.
   4. Door: Flush panel with a core of mineral-fiber insulation enclosed in sheet metal with a minimum thickness of 0.036 inch (0.9 mm).
   5. Frame: Minimum 0.060 inch (1.5 mm) thick sheet metal with 1 inch (25 mm) wide, surface-mounted trim.
   6. Hinges: Continuous piano.
   7. Automatic Closer: Spring type.
   8. Lock: Self-latching device with cylinder lock.

E. Tile-ready Recessed Access door.
   1. Locations: Tiled Walls and Ceilings, only where indicated. Typical access doors for tiled areas are flush.
   2. Size: Coordinate size with access requirements and tile size. Provide larger panel than needed for access to time out with tile pattern if necessary.

3. Door: Aluminum extrusion with tile backer fitted in door panel.
4. Frame: Aluminum extrusion 6063-T6 recessed to provide similar edge to allow for even finishing of wall or ceiling surface.
5. Hinge: Wing hinge with 90 degree opening with removable door.
6. Gasket: Dust Gasket.
7. Lock: Cylinder.
    a. Lock Preparation: Section 08 71 00 - Door Hardware.

2.03 FABRICATION

A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.

B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of supports indicated.
    1. Exposed Flanges: Nominal 1 to 1-1/2 inches (25 to 38 mm) wide around perimeter of frame.
    2. Provide mounting holes in frames for attachment of units to metal or wood framing.
    3. Provide mounting holes in frame for attachment of masonry anchors.

D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.
    1. For cylinder lock, furnish 2 keys per lock and key all locks alike.
    2. For recessed panel doors, provide access sleeves for each locking device. Furnish plastic grommets and install in holes cut through finish.

PART 3 EXECUTION

3.01 INSTALLATION

A. Comply with manufacturer's written instructions for installing access doors and frames.

B. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces.

C. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

D. Paint access panels according to the wall finish; see section 09 91 00.

3.02 ADJUSTING AND CLEANING

A. Adjust doors and hardware after installation for proper operation.

B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION

SECTION 08 36 16
SINGLE-PANEL DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Single-panel tilt-up doors, electrically operated.

B. Exterior cladding for door panels.

C. Interior cladding for door panels.

D. Door opening frame structure.

1.02 RELATED REQUIREMENTS

A. Section 01 33 00 - Submittal Procedures.

B. Section 01 40 00 - Quality Requirements.

C. Section 01 60 00 - Product Requirements.

D. Section 01 92 00 - Facility Operation and Maintenance.

E. Section 05 50 00 - Metal Fabrications

F. Section 07 92 00 - Joint Sealants

G. Section 08 81 00 - Glazing

H. Section 26 05 83 - Wiring Connections.

1.03 DEFINITIONS

A. Electrically Operated Door: A rigid single-panel door hinged along the horizontal header of the opening and is commonly actuated with linear actuators mounted to each vertical jamb of the opening. The door opens from the bottom to the top of the opening, and door panel extends horizontally out from the top of the opening in fully open position.

B. Rigid Doors. A door made in one rigid piece designed to close an entire opening. Opening and closing are accomplished by pivoting the door about an axis, with or without a horizontal track to guide the top of the door.

C. Tilt-Up Door: Door made of a single panel that pivots from the fully closed position to the fully open position which is horizontal and above the floor. Each single panel is rigid.

1.04 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

B. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished; 2018.

C. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2021.

D. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.

E. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

F. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.

G. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.

H. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.

I. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021, with Errata (2023).

J. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).

K. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).

L. ITS (DIR) - Directory of Listed Products; Current Edition.

M. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

N. UL (DIR) - Online Certifications Directory; Current Edition.

O. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; request attendance by affected installers; review preparation and installation procedures and coordination and scheduling necessary for related work.

1.06 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Door Product Data: Include component construction, anchorage method, power unit, actuating device, and hardware.

C. Door Shop Drawings: Indicate opening dimensions and required tolerances, connection details, anchorage spacing, hardware locations, and installation details. Include summary of forces and loads applied to door opening framing members and building structure.

D. Door Opening Frame Structure Shop Drawings: Indicate dimensions, locations of load-bearing members, bracing, connections, attachments, cambers, and loads; general construction details, anchors and methods of anchorage; indicate welded connections with AWS A2.4 welding symbols; indicate net weld lengths.

E. Design Documents: Drawings and calculations signed and sealed by Design Professional. Design door and door opening frame structure to same loading criteria for live, dead, seismic, and wind loads as the surrounding construction.

F. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.

G. Manufacturer's qualification statement.

H. Installer's qualification statement.

I. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.
   3. See Sections 01 33 00 and 01 60 00.

J. Operation Data: Normal operation, troubleshooting, and adjusting.

K. Maintenance Data: Motor and transmission, shaft and gearing, lubrication frequency, spare part sources.

L. Specimen warranty.

1.07 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Designer Qualifications: Perform design of door panel framing structure under direct supervision of Professional Structural Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

D. Installer Qualifications: Company specializing in performing work of type specified and with at least three years documented experience and approved by manufacturer.

E. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and AWS D1.2/D1.2M and dated no more than 12 months before start of scheduled welding work.

F. Comply with applicable code for motor and motor control requirements.

G. Products Requiring Electrical Connection: Listed and classified by ITS (DIR), UL (DIR), or testing firm acceptable to authorities having jurisdiction, as suitable for purpose specified.

1.08 WARRANTY

A. See Section 01 77 00 - Closeout Procedures for additional warranty requirements.

B. Manufacturer's Warranty: Provide 2-year manufacturer warranty for electric operating equipment, Complete forms in Owner's name and register with manufacturer.

C. Manufacturer's Warranty: Provide 2-year manufacturer warranty for a period fo two (2) years from original purchase.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Single-Panel Electrically-Operated Doors:
   1. EVO-Vue by Renlita, 903-308-3309, www.evo-doors.com, www.renlitausa.com.
   2. Substitutions: Not permitted.

2.02 DESIGN CRITERIA

A. Regulatory Requirements: As a minimum, comply with applicable code criteria for loads, including seismic loads.

B. Design Loads: As indicated on drawings.

2.03 PERFORMANCE REQUIREMENTS

2.04 SINGLE-PANEL TILT-UP DOORS, ELECTRICALLY OPERATED

A. Description: Assemblies consisting of primary door panel framing members, secondary framing members, exterior face cladding, lift mechanism with lift cables, electrical components, and interior face cladding.

B. Product: EVO-Vue
   1. Door Panel: Manufacturer's custom design for intended application.
      a. Nominal Size: As indicated on drawings.
      b. Primary Framing Structure: Structural steel tubing.
      c. Secondary Framing: Welded structural steel tubing.
      d. Exterior Face Longitudinal Truss: Welded structural steel tubing, integral with bottom framing member of door panel.
      e. Exterior Face Cladding: Metal wall panels.
      f. Interior Face Cladding: Metal wall panels.
   2. Operation: Manufacturer's standard. Evo-Drive
      a. Operators and Control Stations: Provide products listed by ITS (DIR), UL (DIR), or testing agency acceptable to authorities having jurisdiction.
      b. Comply with UL 325 when required by authority having jurisdiction.
      c. Power Units:
         1) Motor Rating: As required for proper operation; continuous duty.
         2) Motor Voltage: Electrical service characteristics indicated on drawings.
         3) Manual override in case of power failure.
         4) See Section 26 05 83 for electrical connections.
      d. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated; enclose terminal lugs in terminal box, sized to comply with NFPA 70.
      e. Control Station: Provide standard Two-button Open-Close control device for each door.

1) 24-volt circuit.
2) Surface mounted, at or near interior door jamb.

3. Lift Mechanism: Manufacturer's standard design for intended application.

2.05 EXTERIOR CLADDING FOR DOOR PANELS

A. Metal Panel Cladding:
1. Manufacturer's standard metal panels.

2.06 INTERIOR CLADDING FOR DOOR PANELS

A. Metal Panel Cladding:
1. Manufacturer's standard metal panels.

2.07 DOOR OPENING FRAMING STRUCTURE

A. Design to accommodate horizontal and vertical loads while supporting the door and lift mechanism in every position.

B. Framing Components: As required for structural design.

2.08 MATERIALS

A. Aluminum Sheet: ASTM B209/B209M, 5005 alloy, H14 temper, plain surface.

B. Aluminum Extrusions: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper.

C. Finish Color: As selected by Architect.

D. Steel Components:
1. Steel Shape and Flat Sections: ASTM A36/A36M.
2. Steel Tubing: ASTM A501/A501M hot-formed structural tubing.
3. Hinge Pins: Machined from steel complying with requirements of ASTM A108, Grade 4140.

E. Glazing Panes: Type and thickness as required for each application.
1. Float Glass:
a. Heat-Strengthened and Fully Tempered Types: ASTM C1048.
b. Glazing, Insulating Glass: 1 Inch dual pane insulated glass.
1) See Section 08 81 00.
2. Glazing Wedges: Co-extrusions, fitted between aluminum profiles.

F. Insulation: Foamed-in-place polyurethane, bonded to facing.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that wall openings are ready to receive work and opening dimensions and tolerances are within specified limits.

B. Verify that structural building elements at head and jambs of opening are constructed to adequately receive and support door panel and lift mechanisms.

C. Verify that electric power is available in correct locations and has correct characteristics.

3.02 PREPARATION

A. Prepare opening to permit correct installation of door unit to perimeter air and vapor barrier seal.

B. Apply primer to wood frame.

3.03 INSTALLATION

A. Install door unit assembly in accordance with manufacturer's instructions.

B. Anchor assembly to wall construction and building framing without distortion or stress.

C. Securely brace door tracks suspended from structure. Secure tracks to structural members only.

D. Fit and align door assembly including lift mechanisms.

E. Coordinate installation of electrical service. Complete power and control wiring from disconnect to unit components.

F. Install perimeter trim.

3.04 TOLERANCES

A. Maximum Variation from Plumb: 1/16 inch (1.5 mm).

B. Maximum Variation from Level: 1/16 inch (1.5 mm).

C. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch (3 mm) from 10-foot (3 m) straight edge.

D. Maintain dimensional tolerances and alignment with adjacent work.

3.05 ADJUSTING

A. Adjust door assembly for smooth operation and full contact with weatherstripping.

3.06 CLEANING

A. Clean doors and frames and glazing.

B. Remove temporary labels and visible markings.

3.07 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

B. Do not permit construction traffic through overhead door openings after adjustment and cleaning.

END OF SECTION

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SECTION 08 38 00
TRAFFIC DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Traffic doors.

1.02 RELATED SECTIONS

A. Section 01 33 00 - Submittal Procedures.

B. Section 01 40 00 - Quality Requirements.

C. Section 01 60 00 - Product Requirements.

D. Section 06 10 00 - Rough Carpentry.

E. Section 06 64 00 - Plastic Paneling.

F. Section 08 71 00 - Door Hardware.

G. Section 09 21 16 - Gypsum Board Assemblies

1.03 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00.

1.04 SUBMITTALS

A. Material and Equipment Submittals: Submit the following under provisions of Section 01 33 00-Submittals:
   1. Shop Drawings: Indicate elevations, size, location, color and installation details.
   2. Product data.
   3. Samples: Submit sample for door cladding material for final color approval.
   4. Installation Instructions.

B. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.
   3. See Sections 01 33 00 and 01 60 00.

PART 2 PRODUCTS

2.01 TRAFFIC DOORS

A. Rigid Traffic Door (Café): Double-acting, self-closing, 3/4" thick solid core door body with 0.032” thick decorative plastic laminate applied to both sides of door. Size as indicated on Drawings.
   1. Eliason Easy Swing Door Division, Model ENG-1.
   2. Finish: Non-standard, 0.032” thick decorative laminate finish. Color to match PLAM-19, or as selected by the Architect.
   3. Vision Panels: 9” x 14” vision panel glazed with clear acrylic.
   4. Hardware: Manufacturer's standard.
   5. Trim: Provide 18 gauge stainless steel edge trim and top hardware cover plates.
   6. Base Plates: 18” high stainless steel base plates both sides of door.
   7. Jamb Guards: 5” x 9” stainless steel welded assembly of ¼” steel.

B. Rigid Insulated Traffic Door (Bistro): Double-acting, self-closing, 3 3/4” thick, foamed-in-place monolithic door panel with an outer skin thickness of .125”. Core foam to be CFC-Free urethane foam, providing and R-Value of 25.
   1. Chase Doors, Model Durulite R25 Insulated Cooler Door. Or approved equal.
   2. Finish: Color to be “Beige” or as selected by the Architect from manufacturer’s standard colors.
   3. Vision Panel: 12”x18” triple pane polycarbonate.
   4. Hinge: By Manufacturer, double acting.
   5. Gasketing: Replaceable Perimeter edge gasketing.

6.
7. Spring Bumpers: None.
8. Jamb Guard: 5”x18” Jamb Guard.
9. Push Plates: None.

C. Rigid Traffic Gate (Bistro): Double-acting, self-closing, 1/2" thick solid core door body with 0.125” thick high impact thermoplastic exterior laminate applied to both sides of door. Size as indicated on Drawings.
   1. Eliason Easy Swing Door Division, Model P11- Plus Gate.
   2. Finish: High impact thermoplastic exterior laminate applied to both sides of door. Color to be selected by the Architect from manufacturer’s color chart.
   3. Hardware: Manufacturer's standard.
   4. Gate Post Size: Refer to drawings for door/ post height.
   5. Gate Post Finish: Powder coated scratch resistant steel post color to be “black” or as selected by architect.
   6. Gate Post Mounting: Threaded 3” floor anchors at 4 points of contact. (anchor bolts to be mounted to concrete slab. Finished tile floor to cover anchor bolts).
   7. Gate Post Hardware: Eliason EasySwing Hardware

D. Rigid Traffic Gate (Bar): Double-acting, self-closing, 1/2" thick, foamed-in-place monolithic door panel with an outer skin thickness of 0.125”, applied to both sides of door. Size as indicated on Drawings.
   1. Eliason Easy Swing Door Division, Model P11- Plus Gate.
   2. Finish: Non-standard, 0.032" thick decorative laminate finish. Color to match PLAM-19, or as selected by the Architect.
   3. Hardware: Manufacturer's standard.
   4. Gate Post Size: Refer to drawings for door/post height.
   5. Gate Post Finish: Powder coated scratch resistant steel post color to be “black” or as selected by architect.
   6. Gate Post Mounting: Threaded 3” floor anchors at 4 points of contact. (anchor bolts to be mounted to concrete slab. Finished tile floor to cover anchor bolts).
   7. Gate Post Hardware: Eliason Easy Swing Hardware

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify door openings are prepared with headers and floors level, jambs plumb, without projections, and of specified dimensions.

B. Verify jambs of frames are properly reinforced at hinge locations.

C. Beginning of installation means acceptance of existing conditions.

3.02 INSTALLATION

A. Install traffic doors according to Manufacturer's installation instructions. Adjust and leave in good operating order.

3.03 PROTECTION

A. Protect door according as recommended by traffic door manufacturer to assure that doors will be without damage at time of Substantial Completion.

END OF SECTION

SECTION 08 41 13
ALUMINUM FRAMED ENTRANCES AND STOREFRONTS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Exterior storefront framing.
   2. Interior storefront framing.
   3. Sealants.
   4. Hardware (refer to Section 08 71 00 for hardware set information)

1.02 DEFINITIONS

A. ADA Standards, ADA/ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disability Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities."

1.03 RELATED SECTIONS

A. Section 01 33 00 - Submittal Procedures.

B. Section 01 40 00 - Quality Requirements.

C. Section 01 60 00 - Product Requirements.

D. Section 01 92 00 - Facility Operation and Maintenance.

E. Section 03 45 00 - Architectural Site Cast Concrete Wall Panels.

F. Section 04 20 00 - Unit Masonry Assemblies.

G. Section 05 12 00 - Structural Steel Framing.

H. Section 05 31 00 - Steel Decking.

I. Section 05 40 00 - Cold-Formed Metal Framing.

J. Section 06 10 00 - Rough Carpentry.

K. Section 07 21 00 - Thermal Insulation.

L. Section 07 27 26 - Fluid Applied Membrane Air Barriers.

M. Section 07 62 00 - Sheet Metal Flashing and Trim.

N. Section 07 84 00 - Firestopping.

O. Section 07 92 00 - Joint Sealants.

P. Section 08 08 00 - Commissioning of Openings

Q. Section 08 71 00 - Door Hardware.

R. Section 08 81 00 - Glazing.

S. Section 09 21 16 - Gypsum Board Assemblies.

1.04 REFERENCE STANDARDS

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; Current Edition.

B. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems; 2015.

C. AAMA 503 - Voluntary Specification for Field Testing of Newly Installed Storefronts, Curtain Walls and Sloped Glazing Systems; 2014.

D. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections; 2009.

E. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

F. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

G. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

H. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.

I. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2023, with Editorial Revision.

J. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.

K. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.

L. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

M. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.

N. ASTM B308/B308M - Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles; 2020.

O. ASTM B429/B429M - Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube; 2020.

P. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.

Q. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2019.

R. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).

S. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2023).

T. ASTM E783 - Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors; 2002 (Reapproved 2018).

U. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference; 2015 (Reapproved 2023).

V. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

W. SSPC-PS 12 - Guide to Zinc-Rich Coating Systems; Current Edition.

X. ADAAG Americans with Disabilities Act Accessibility Guidelines.

1.05 PERFORMANCE REQUIREMENTS

A. Prepare design drawings and calculations under seal of a Professional Structural Engineer licensed in the state/province of the project and fully experienced in the design of curtainwall framing systems.

B. General Performance: Aluminum-framed systems shall withstand the effects of the following performance requirements without exceeding performance criteria or failure due to defective manufacture, fabrication, installation, or other defects in construction:
   1. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
   2. Dimensional tolerances of building frame and other adjacent construction.

3. Failure includes the following:
    a. Deflection exceeding specified limits.
    b. Thermal stresses transferring to building structure.
    c. Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
    d. Noise or vibration created by wind and by thermal and structural movements.
    e. Loosening or weakening of fasteners, attachments, and other components.
    f. Sealant failure.
    g. Failure of operating units.

C. Structural Loads:
    1. Wind Loads: Design wind pressures shall be based on Basic Wind Speed, Risk Category, Exposure Category, and Internal Pressure Coefficient indicated on Structural Drawings.

D. Member Deflection:
    1. For spans less than 13'-6", limit member deflection to the flexure limit of glass in any direction, and maximum of L/175 of span or ¾ inch, whichever is less wand with full recovery.

E. Structural-Test Performance: Provide aluminum-framed systems tested according to ASTM E330/E330M as follows:
    1. When tested at positive and negative wind-load design pressures, systems do not evidence deflection exceeding specified limits.
    2. When tested at 150 percent of positive and negative wind-load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
    3. Test Durations: As required by design wind velocity, but not fewer than 10 seconds.

F. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of 0.06 CFM/SF @ 6.24 psf (. (30.47 ksf/sq. m) of fixed wall area when tested according ASTM E283/E283M at a minimum static-air-pressure difference of 1.57 lbf/sq. ft. (75 Pa). Operable door units shall not exceed 1.0 cfm/sq ft at 1.57 psf pressure differential.

G. Water Penetration under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 8 lbf/sq. ft.

H. Thermal Movements: Provide aluminum-framed systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
    1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
    2. Interior Ambient-Air Temperature: 75 deg F (24 deg C).

I. Thermal Conductance:
    1. Fenestration Maximum U-Factor:
       Fixed fenestration: 0.36
       Operable fenestration: 0.45
       Entrance doors: 0.63
       SHGC:
       PF < 0.2 - Fixed: 0.38 Operable: 0.33
       PF 0.2 ≤ PF < 0.5 Fixed: 0.46 Operable: 0.40
       PF ≥ 0.5 Fixed: 0.61 Operable: 0.53
    2. Run thermal analysis of as-designed window installation with perimeter conditions to determine risk of interior condensation in pool area.

J. Condensation Performance: Condensation Resistance Factor (CRF) Minimum of 77 at assemblies around pool areas.

1.06 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for aluminum-framed systems.

B. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.
   1. Include details of provisions for system expansion and contraction and for drainage of moisture in the system to the exterior.
   2. For entrance doors, include hardware schedule and indicate operating hardware types, functions, quantities, and locations.
   3. Provide full project specific structural calculations in compliance with referenced documents, all applicable codes and these specifications. Submit stamped calculations by P.E. including framing attachment and Insulated Glazing Units.

C. Fabrication Sample: Of each vertical-to-horizontal intersection of aluminum-framed systems, made from 12-inch (300-mm) lengths of full-size components and showing details of the following:
   1. Joinery, including concealed welds.
   2. Anchorage.
   3. Expansion provisions.
   4. Glazing.
   5. Flashing and drainage.

D. Material Finish Sample for review and approval by Architect prior to releasing windows for fabrication.

E. Sealant Color Samples for selection.

F. Other Action Submittals:
   1. Entrance Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

G. Qualification Data: For qualified Installer.

H. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for aluminum-framed systems, indicating compliance with performance requirements. Test reports shall be no more than five years old and shall apply to correct standards.

I. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.
   3. See Sections 01 33 00 – Submittal Procedure and 01 60 00 – Product Requirements.

J. Operation and Maintenance Data: Submit O&M manuals according to the requirements of Section 01 92 00 - Facility Operation and Maintenance.

K. Warranties: Sample of special warranties.

1.07 ADMINISTRATIVE REQUIREMENTS

A. Pre-Submittal Hardware and Keying Meeting: Prior to preparing final submittals, conduct meeting including Owner, Architect, and supplier of hardware to determine the following:
   1. Lock Function: Demonstrate function/type of each lockset scheduled and verify function at each door.
   2. Electrical Operation: Verify function of openings requiring electrified hardware.
   3. Keying: Determine keying requirements for preparation of final keying schedule.
   4. Submit letter of compliance, indicating when this meeting was held and who was in attendance, to Architect, Owner, and hardware supplier.

B. Pre-Installation Conference

1. Convene a pre-installation conference under provisions of Section 01 31 00 - Project Management and Coordination prior to commencing work of this Section.
    a. Attendance required of Contractor, system installer, and parties directly affecting work of this Section.
    b. Review conditions of installation, installation procedures and coordination required with Related Work.
    c. Coordinate Keying, Compatibility and appearance of visible hardware with hardware provider.

1.08 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Manufacturer’s qualifications: minimum of ten years of experience in the manufacture of similar glass and metal systems with success.

C. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project. Minimum of five years of successful experience in the installation of systems similar to those required.

D. Engineering Responsibility: Prepare data for aluminum-framed systems, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in systems similar to those indicated for this Project.

E. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.

F. Accessible Entrances: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC A117.1.

G. Source Limitations for Aluminum-Framed Systems: Obtain each type and variety of aluminum, steel and wood hardware from the same manufacturer, unless otherwise indicated.

H. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
    1. Test Mockup according to ASTM E783, ASTM E1105 spray wand testing to ensure performance.
    2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

I. Field Testing:
    1. Submit results of field tests as required in Part 3.

1.09 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
    1. Failures include the following:
        a. Structural failures including, but not limited to, excessive deflection.
        b. Noise or vibration caused by thermal movements.
        c. Deterioration of metals and other materials beyond normal weathering.
        d. Adhesive or cohesive sealant failures.
        e. Water leakage through fixed glazing and framing areas.
        f. Failure of operating components.
    2. Warranty Period: 5 years from date of Substantial Completion.
    3. Sub-Contractor 2 year warranty for all work.

4. Provide finish coating warranty.

1.10 MAINTENANCE SERVICE

A. Entrance Door Hardware:
   1. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of entrance door hardware.

PART 2 PRODUCTS

2.01 EXTERIOR STOREFRONT

A. Basis-of-Design Product: Subject to compliance with requirements, provide Kawneer Trifab 451UT, or comparable product by one of the following:
   1. EFCO Corporation, Xtherm 403X.
   2. Tube Lite, 1400 TU
   3. Oldcastle Building Envelope, 3000XT.
   4. Midland Glass Company.
   5. CMI Architectural Products, Inc.

2.02 INTERIOR STOREFRONT

A. Provide interior, non-thermally broken storefront system for interior aluminum doors and frames from the same manufacturer as the Exterior storefront.

B. Basis-of-Design Product: Subject to compliance with requirements, provide INT14 Interior Flush Glaze System. or comparable product by one of the following:
   1. EFCO Corporation.
   2. Kawneer North America.
   3. Oldcastle Building Envelope.
   4. Midland Glass Company.
   5. CMI Architectural Products, Inc.
   6. Or approved equal.

2.03 MATERIALS

A. Aluminum: Alloy and 6063-T6 temper recommended by manufacturer for type of use and finish indicated.
   1. Sheet and Plate: ASTM B209/B209M.
   2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221, ASTM B221M.
   3. Extruded Structural Pipe and Tubes: ASTM B429/B429M .
   4. Structural Profiles: ASTM B308/B308M.

B. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer, complying with SSPC-PS 12; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.
   1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
   2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
   3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.

2.04 FRAMING SYSTEMS

A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.
   1. Construction: Thermally broken at Exterior Framing and Non-thermal at Interior Framing.
   2. Glazing System: Retained mechanically with gaskets on four sides.
   3. Glazing Plane: As indicated.

B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with non-staining, nonferrous shims for aligning system components.

C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, non-staining, non-bleeding fasteners and accessories compatible with adjacent materials.
   1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
   2. Reinforce members as required to receive fastener threads.

D. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts, complying with ASTM A123/A123M or ASTM A153/A153M.

E. Concealed Flashing: Manufacturer's standard corrosion-resistant, non-staining, non-bleeding flashing compatible with adjacent materials.

F. Framing System Gaskets and Sealants: Manufacturer's standard, recommended by manufacturer for joint type.
   1. Provide sealants for use inside of the weatherproofing system that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

G. Storefront:
   1. Sub-sill shall be anchored to continuous interior aluminum angle. Anchorage down through the bottom (Horizontal Portion) of the sub-sill is not acceptable. Interior angle size and attachment to storefront system and to perimeter framing to be engineered and installed as part of this work. Show angle and anchors on shop drawings. Stamped and signed by Professional Engineer.
   2. Seal joints in sub-sill with silicone tape, including transverse joints, mitered corners, end dams and so on. Reliance on metal splice plates and/or sealant is unacceptable.
   3. Provide reinforcing of mullion framing, as necessary, to meet design loads per project specific structural calculations.

H. Aluminum Frames for Doors, Sidelights, or Transoms: Extruded aluminum, non-thermally broken hollow or C-shaped sections; no steel components
   1. Frame Depth: To fit wall thicknesses as indicated on drawings.
   2. Profiles:
      a. Typical frames:
         1) Double rabbets, see Door Schedule for size.
         2) .5" stop.
      b. Single rabbetted frames, see Door Schedule.
         1) Stopless frame with custom aluminum tube stop each side, as shown on detail.
         2) Custom aluminum tube stop sized to accommodate magnetic lock and finished to match frame. See details and section 08 71 00.
         3) Exposed top of frame:
            (a) Cover exposed end with aluminum cap with eased edges, finish to match.
            (b) Cover exposed end of aluminum tube stop with LDPE plastic cap with eased edges.
               (1) Color to match frame.
               (2) Top of plastic cap to be flush with aluminum cap.
               (3) Permanently adhere cap to tube.
         4) Contractor's option: fabricate single rabbetted frame to match profile on detail and accommodate magnetic lock.
            (a) Cap frame to match.
   3.

2.05 GLAZING SYSTEMS

A. Glazing: As specified in Section 08 81 00 - Glazing.

B. Glazing Gaskets: Manufacturer's standard compression types; replaceable, molded or extruded, of profile and hardness required to maintain watertight seal.

C. Spacers and Setting Blocks: Manufacturer's standard silicone type.

2.06 SILICONE SEALANTS

A. Provide sealed end caps at tops of vertical mullions, thermally-broken caulk-stops at jamb and head conditions, and other accessories needed.

B. See Section 07 92 00 for glazing sealants.

C. Single-Component, Non-sag, Neutral-Curing Silicone Joint Sealant: ASTM C920, Type S, Grade NS, Class 50, for Use NT. Color: Submit full range for Architect's selection.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Dow Corning Corporation; 791, 795, 995, or 999-A.
      b. GE Advanced Materials - Silicones; SilGlaze II SCS2800, SilPruf NB SCS900,0 SilPruf SCS2000, and UltraPruf II SCS2900.
      c. Pecora Corporation; 864.
      d. Tremco Incorporated; Spectrem 2 or Spectrem 3.
   2. Provide sealants for use inside of the weatherproofing system that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.07 ENTRANCE DOOR SYSTEMS

A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.
   1. Door Construction: 1-3/4-inch (44.5-mm) overall thickness, with minimum 0.125-inch- (3.2-mm-) thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods. No thermal break.
   2. Door Design: Wide stile; 5-inch (127-mm) nominal width.
      a. Accessible Doors: Smooth surfaced for width of door in area within 10 inches (255 mm) above floor or ground plane.
   3. Glazing Stops and Gaskets: Beveled, snap-on, extruded-aluminum stops and preformed gaskets.
      a. Provide non-removable glazing stops on outside of door.

2.08 ENTRANCE DOOR HARDWARE

A. General: Provide entrance door hardware and entrance door hardware sets indicated in Section 08 71 00 - Door Hardware.
   1. Coordinate Keying with Hardware providers and Keying Schedule.

2.09 ACCESSORY MATERIALS

A. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Section 07 92 00 - Joint Sealants.

B. Bituminous Paint: Cold applied asphalt mastic, containing no asbestos fibers.

C. Flashing: See Section 07 62 00.

2.10 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:
   1. Profiles that are sharp, straight, and free of defects or deformations.
   2. Accurately fitted joints with ends coped or mitered.
   3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
   4. Physical and thermal isolation of glazing from framing members.
   5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
   6. Provisions for field replacement of glazing from interior for vision glass and exterior for spandrel glazing or metal panels.

7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

C. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

D. Storefront Framing: Fabricate components for assembly using screw-spline system.

E. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
   1. At exterior doors, provide compression weather stripping at fixed stops.

F. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
   1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
   2. At exterior doors, provide weather sweeps applied to door bottoms.

G. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.

H. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.11 ALUMINUM FINISHES

A. Dark Bronze Finish: AAMA 611, AA-M12C22A, Class 1, 0.018 mm or thicker.

B. Superior Performing Organic Coatings System: Manufacturer's standard multi-coat superior performing organic coatings system complying with AAMA 2605, including at least 70 percent polyvinylidene fluoride (PVDF) resin, and at least 80 percent of aluminum extrusion and panels surfaces having minimum total dry film thickness (DFT) of 1.2 mils, 0.0012 inch (0.030 mm).
   1. Match Color of Anodized Doors.
   2. Apply to Wet suite doors as indicated. See Door Schedule.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. General:
   1. Comply with manufacturer's written instructions.
   2. Do not install damaged components.
   3. Fit joints to produce hairline joints free of burrs and distortion.
   4. Rigidly secure non-movement joints.
   5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
   6. Seal joints watertight unless otherwise indicated.

B. Metal Protection:
   1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or applying sealant or tape, or by installing nonconductive spacers as recommended by manufacturer for this purpose.
   2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior. Install sponge baffles at weep holes.

D. Set continuous sill members and flashing in full sealant bed as specified in Section 07 92 00 - Joint Sealants to produce weather-tight installation. Provide additional sealant as detailed.

E. Install components plumb and true in alignment with established lines and grades, and without warp or rack.

F. Install glazing as specified in Section 08 81 00 - Glazing.

G. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.
   1. Exterior Doors: Install to produce weather-tight enclosure and tight fit at weather stripping.
   2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.
   3. Set threshold in full sealant bed as specified in Section 07 92 00 - Joint Sealants to produce weather-tight installation. See 08 71 00.

H. Install perimeter joint sealants as specified in Section 07 92 00 - Joint Sealants to produce weather-tight installation.
   1. Minimum joint size: 3/8"

3.03 ERECTION TOLERANCES

A. Install aluminum-framed systems to comply with the following maximum erection tolerances:
   1. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet; 1/4 inch over total length.
   2. Alignment:
      a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch.
      b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch (0.8 mm).

B. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch (3 mm).

3.04 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections.
   1. ASTM E1105 – Field Water/Air testing. Contractor to assist with testing by providing safe access, water, power, chamber materials and personnel to perform the tests. If failure occurs, provide additional test assistance as needed to pa ss test at no additional cost.
   2. See Structural drawings for required wind loads and pressures to be tested.
   3. No increase in allowable rate of air infiltration or increase in the volume of water leakage, nor any decrease in the specified test pressures is permitted. Test first frames installed.

B. Repair or remove work if test results and inspections indicate that it does not comply with specified requirements.

C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
   1. Coordinate testing with the requirements of Section 01 91 13. Re-test as required to ensure passing of specimens.

D. Aluminum-framed assemblies will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.05 ADJUSTING

A. Adjust operating entrance door hardware to function smoothly as recommended by manufacturer.
   1. For entrance doors accessible to people with disabilities, adjust closers to provide a 3-second closer sweep period for doors to move from a 70-degree open position to 3 inches (75 mm) from the latch, measured to the leading door edge.

END OF SECTION

SECTION 08 42 45
SLIDING ALUMINUM DOORS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Includes individual panel aluminum and glass door system, including aluminum frame, tracks, sliding panels, stacking bays, anchors, brackets, attachments, sliding and locking hardware, glass and glazing; designed to provide an opening glass wall with sizes and configurations as shown on drawings and specified herein.
      a. Thermally broken at exterior, where occurs on Drawings.

1.02 RELATED REQUIREMENTS

A. Section 01 33 00 - Submittal Procedures.

B. Section 01 40 00 - Quality Requirements.

C. Section 01 60 00 - Product Requirements.

D. Section 01 92 00 - Facility Operation and Maintenance.

E. Section 03 30 00 - Cast in Place Concrete.

F. Section 08 71 00 - Door Hardware.

G. Section 08 81 00 - Glazing.

H. Section 09 21 16 - Gypsum Board Assemblies.

I. Section 09 30 00 - Tiling.

J. Section 09 65 19 - Resilient Tile Flooring.

1.03 PERFORMANCE

A. Provide aluminum sliding doors engineered, fabricated and installed to withstand normal movement and impact loading without failure, as demonstrated by testing manufacturer’s standard sliding door assemblies representing types, grades, classes and sizes required for the Project.

1.04 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Installer Qualifications: Engage an experienced Installer who has completed installation of similar sliding doors in material, design and extent to those required for this Project and with a record of successful in-service performance.

1.05 SUBMITTALS

A. Material and Equipment Submittals: Submit under provisions of Section 01 33 00 - Submittals:
   1. Samples: Samples for Verification: LTF Construction reserves the right to require samples that show fabrication techniques, workmanship and design of hardware and accessories.
   2. Shop Drawings: Include elevations; system and component dimensions; components within assembly; framed opening requirements and tolerances; anchorage and fasteners; reinforcement; glass and infill’s; detailed door hardware schedule; and affected related work.
   3. Product Data: For each type of sliding door; include construction details and fabrication methods, profiles and dimensions of individual components and data on hardware, accessories and finishes.
   4. Manufacturer's Installation Instructions.

B. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.

3. See Sections 01 33 00 and 01 60 00.

C. Closeout Submittals: Submit the following under provisions of Section 01 77 00 - Closeout Procedures:
   1. Warranty: As specified in this Section.

1.06 ADMINISTRATIVE REQUIREMENTS

A. Pre-Submittal Hardware and Keying Meeting: Prior to preparing final submittals, conduct meeting including Owner, Architect, and supplier of hardware to determine the following:
   1. Lock Function: Demonstrate function/type of each lockset scheduled and verify function at each door.
   2. Electrical Operation: Verify function of openings requiring electrified hardware.
   3. Keying: Determine keying requirements for preparation of final keying schedule.
   4. Submit letter of compliance, indicating when this meeting was held and who was in attendance, to Architect, Owner, and hardware supplier.

B. Pre-Installation Conference.
   1. Convene a pre-installation conference under provisions of Section 01 31 00 - Project Management and Coordination prior to commencing work of this Section.
      a. Attendance required of Contractor, system installer, and parties directly affecting work of this Section.
      b. Review conditions of installation, installation procedures and coordination required with Related Work.
      c. Coordinate Keying, Compatibility and appearance of visible hardware with hardware provider.

1.07 PROJECT CONDITIONS

A. Field Measurements: Check door openings by field measurements before fabrication and show recorded measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver, handle, store, and protect system components under provisions of Section 01 60 00 -Product Requirements.

B. Provide wrapping to protect prefinished aluminum surfaces.

1.09 WARRANTY

A. Provide 1 year manufacturer's warranty to cover complete system for failure to meet specified requirements.

PART 2 PRODUCTS

2.01 ALUMINUM SLIDING DOORS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, one of the following:
   1. CR Laurence/US Aluminum: Series 2000 Sliding Glass Doors.
   2. Midland Glass, Custom Aluminum Framed Multiple Track Sliding System.
   3. Or approved substitution.

2.02 MATERIALS

A. Door and frame members shall be extruded architectural aluminum 6063-T5 alloy and temper

B. Major portion of all door sections, except glazing beads, shall be nominal .125 inch (3.2 mm).

C. Wall thickness of frame members shall be nominal .093 inch (2.4 mm).

D. Screws, nuts, washers, bolts, rivets, and other fastening devices shall be aluminum, stainless steel or other non-corrosive materials.

E. Sliding door floor track(s) shall have stainless steel cover cap. Perimeter fasteners shall be aluminum or steel. Steel is to be properly isolated from the aluminum.
   1. Bottom track to be ADA compliant. See details for installation.

F. Glass: As specified in Section 08 81 00 Glazing; fully tempered.

G. Thickness: 1/4 inch (6 mm), or 1 inch (25 mm).

2.03 SLIDING DOOR CONSTRUCTION

A. Aluminum Extrusions: Provide alloy and temper recommended by manufacturer for strength, corrosion resistance and application of required finish for main frame and sash members.

B. Fasteners: Provide aluminum, nonmagnetic stainless steel, epoxy adhesive or other materials warranted by manufacturer to be non-corrosive and compatible with aluminum sliding door members, trim, hardware, anchors and other components.

C. Anchors, Clips and Sliding Door Accessories: Fabricate anchors, clips and sliding door accessories of aluminum, nonmagnetic stainless steel or hot-dip zinc-coated steel or iron of sufficient strength to withstand design pressure.

D. Compression-Type Glazing Strips and Weather-stripping: Unless otherwise indicated, provide compressive stripping for glazing and weather-stripping such as molded EPDM or neoprene gaskets.

E. Sealant: For sealants required within fabricated window units, provide type recommended by manufacturer for joint size and movement. Sealant shall remain permanently elastic, non-shrinking and non-migrating. Comply with Section 07 92 00 - Joint Sealants, for selection and installation of sealants.

2.04 HARDWARE

A. Provide manufacturer’s standard hardware fabricated from aluminum, stainless steel or other corrosion-resistant material compatible with aluminum and of sufficient strength to perform the function for which it is intended.
   1. Coordinate Lock cylinders with hardware supplier.

B. Overhead and floor track (for each aluminum sliding door section), hangers, guides, wheels, locks, recessed pull and noise reduction gaskets shall be provided.

2.05 FINISHES

A. Aluminum Finish:
   1. Dark Bronze Finish: AAMA 611, AA-M12C22A, Class 1, 0.010 mm or thicker.

2.06 GLASS AND GLAZING MATERIALS

A. Glazing Materials: As specified in Section 08 81 00 - Glazing.

2.07 SEALANT MATERIALS

A. Sealant and Backing Materials: As specified in Section 07 92 00 - Joint Sealers.

2.08 ACCESSORIES

A. Fasteners: Aluminum or non-magnetic stainless steel, or other corrosion resistant material warranted by manufacturer to be non-corrosive and compatible with aluminum components. Avoid use of exposed fasteners. Provide matching Phillips flat-head screws for exposed fasteners.

B. Glazing Accessories: Manufacturer's standard elastomeric glazing gaskets and setting blocks designed specifically for specified system.

2.09 FABRICATION

A. Fabricate doors and frames allowing for minimum clearances and shim spacing around perimeter of assembly. Shop fabricate frame components where possible.

B. Rigidly fit and secure joints and corners with internal reinforcement. Make joints and connections flush, hairline, and weatherproof.

C. Arrange fasteners, attachments, and jointing to ensure concealment from view.

D. Provide internal reinforcement for all door hardware components as required.

PART 3 EXECUTION

3.01 INSPECTION

A. Verify wall openings and adjoining air and vapor seal materials are ready to receive work of this Section.

B. Beginning of installation means acceptance of existing conditions.

3.02 INSTALLATION

A. Comply with manufacturer's specifications and recommendations for installing sliding door units, hardware, and other components of the Work.

B. Set sliding door units plumb, level and true to line, without warp or rack of frames or sash. Provide proper support and anchor securely in place.

C. Use anchorage devices to securely attach frame assembly to structure.

D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.

E. Install glass in accordance with Section 08 81 00, using dry method of glazing.

F. Install perimeter sealant and backing materials, in accordance with Section 07 92 00 - Joint Sealers.

G. Install hardware in accordance with Section 08 71 00 - Door Hardware.

3.03 ADJUSTING

A. Adjust operating entrance door hardware to function smoothly as recommended by manufacturer.

END OF SECTION

SECTION 08 44 13
GLAZED ALUMINUM CURTAINWALL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Aluminum curtain wall framing.

B. Anchors, brackets, attachments, and cap flashing as indicated.

1.02 RELATED STANDARDS

A. Section 01 31 00 - Project Management and Coordination.

B. Section 01 33 00 - Submittal Procedures.

C. Section 01 40 00 - Quality Requirements.

D. Section 01 60 00 - Product Requirements.

E. Section 03 45 00 - Precast Architectural Concrete.

F. Section 04 20 00 - Unit Masonry Assemblies.

G. Section 05 12 00 - Structural Steel Framing.

H. Section 05 31 00 - Steel Decking.

I. Section 05 40 00 - Cold-Formed Metal Framing.

J. Section 06 10 00 - Rough Carpentry.

K. Section 07 21 00 - Thermal Insulation.

L. Section 07 27 26 - Fluid Applied Membrane Air Barrier.

M. Section 07 62 00 - Sheet Metal Flashing and Trim.

N. Section 07 84 00 - Firestopping.

O. Section 07 92 00 - Joint Sealants.

P. Section 08 08 00 - Commissioning of Openings.

Q. Section 08 71 00 - Door Hardware.

R. Section 08 81 00 - Glazing.

1.03 REFERENCE STANDARDS

A. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems; 2015.

B. AAMA 503 - Voluntary Specification for Field Testing of Newly Installed Storefronts, Curtain Walls and Sloped Glazing Systems; 2014.

C. AAMA 611 - Specification for Anodized Architectural Aluminum; 2024.

D. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections; 2009.

E. AAMA CWM - Curtain Wall Manual; 2019.

F. ADAAG - Americans With Disabilities Act Accessibility Guidelines; 2010.

G. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

H. ASTM A446/A446M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality; Current edition.

I. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.

J. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

K. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.

L. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2019.

M. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).

N. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2023).

O. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference; 2015 (Reapproved 2023).

1.04 PERFORMANCE

A. Prepare design drawings and calculations under seal of a Professional Structural Engineer licensed in the state/province of the project and fully experienced in the design of curtainwall framing systems.

B. Full design and detail structural connections of curtainwall system to building. Consult with building structural engineer before transferring any loads back to building structure.

C. System to provide for expansion and contraction within system components caused by a cycling temperature range of 170 F deg. without causing detrimental effects to system or components.

D. Design and size members to withstand dead loads and live loads caused by pressure and suction of wind to the design pressures as measured in accordance with ASTM E330/E330M.
   1. Wind Loads: Design wind pressures shall be based on Basic Wind Speed, Risk Category, Exposure Category, and Internal Pressure Coefficient indicated on Structural Drawings.

E. Member Deflection: for spans less than 13 feet 6 inches, limit member deflection to flexure limit of glass in any direction, and maximum of L/175 of span or ¾ inch, whichever is less and with full recovery of glazing materials.

F. Drain water entering joints, condensation occurring in glazing channels, or migrating moisture occurring within system, to exterior.

G. Air Infiltration: Limit air infiltration through curtainwall framing assembly to 0.06 cfm/sq ft at a static air pressure differential of 6.24 psf, when tested in accordance with ASTM E283/E283M.

H. Water Resistance (dynamic): System shall demonstrate no water penetration at a test pressure of 15.00 psf as measured in accordance with ASTM E331.

I. System to accommodate, without damage to system or components, or deterioration of perimeter seal: Movement within system; movement between system and perimeter framing components; dynamic loading and release of loads; and deflection of structural support framing.

J. Condensation Resistance Factor: CRF minimum of 77 when tested in according to AAMA 1503.

K.
Fenestration Maximum U-Factor:
Fixed fenestration: 0.36
Operable fenestration: 0.45
Entrance doors: 0.63
SHGC:
PF < 0.2 - Fixed: 0.38 Operable: 0.33
PF 0.2 ≤ PF < 0.5 Fixed: 0.46 Operable: 0.40
PF ≥ 0.5 Fixed: 0.61 Operable: 0.53

1.05 SUBMITTALS

A. Material and Equipment Submittals:
   1. Calculations: Submit design calculations with engineer's stamp showing assembly meets requirements of Part 1.04 above.

B. Shop Drawings: Prepared by curtainwall framing manufacturer (Delegated Design); including elevations, system dimensions, framed opening requirements and tolerances, anticipated deflection under load, affected related Work, weep drainage network, expansion and contraction joint location and details, and field welding required. Provide large-scale details of entrance doors detailed hardware schedule. Stamp drawings by Designer of Record.
   1. Samples: Submit samples of anodized aluminum finish for final color approval.
   2. Installation Data: Special installation requirements.
   3. Indicate connection to, and continuity with adjacent thermal, weather, air and vapor barrier.

C. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.
   3. See Sections 01 33 00 and 01 60 00.

D. Mock-Ups: Provide mock-up of sufficient size to show all components of the system to be installed.
   1. See drawings for information on required mock-ups.
   2. Coordinate work on mock-up with work of other sections.

E. Closeout Submittals:
   1. Warranty: As specified in this Section.

1.06 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Perform Work in accordance with AAMA CWM - Metal Curtain Wall, Window, Store Front and Entrance - Guide Specifications Manual. Maintain one copy on site.

C. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum 5 years' experience.

D. Installer Qualifications: Company specializing in performing the work of this section with minimum five years experience and approved by manufacturer.

E. Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State of Project.

F. Manufacturer Qualifications: Minimum of 5 years experience in manufacturing exterior sun control devices similar to those specified.

G. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the jurisdiction where the project is located and who is experienced in providing engineering services of kind indicated. Engineering services are defined as those performed for installations of sun controls that are similar to those indicated for this project in material, design and extent.

1.07 PRE-INSTALLATION MEETING

A. Convene a pre-installation conference under provisions of Section 01 31 00 - Project Management and Coordination one-week prior to commencing work of this Section.
   1. Attendance required of Contractor, system installer, and parties directly affecting work of this Section.
   2. Review conditions of installation, installation procedures and coordination required with Related Work.
   3. Coordinate Keying, Compatibility and appearance of visible hardware with hardware provider.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver, handle, store, and protect system components under provisions of Section 01 60 00-Material and Equipment.

1.09 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
   1. Failures include the following:
      a. Structural failures including, but not limited to, excessive deflection.
      b. Noise or vibration caused by thermal movements.
      c. Deterioration of metals and other materials beyond normal weathering.
      d. Adhesive or cohesive sealant failures.
      e. Water leakage through fixed glazing and framing areas.
      f. Failure of operating components.
   2. Warranty Period: 5 years from date of Substantial Completion.
   3. Sub-Contractor 2 year warranty for all work.

PART 2 PRODUCTS

2.01 CURTAINWALL FRAMING SYSTEMS

A. Curtainwall Framing: Aluminum extrusions conforming to ASTM B221, alloy 6060-T5; thermally improved, exterior glazed pressure plate type curtainwall system framing system to accept 1" insulated glazing; 2-1/2" wide face dimension x depth as indicated on Drawings. Must accept primary seal at shoulder of curtain wall mullion, directly behind glazing. See details.
   1. “Basis of Design” Kawneer Company, Inc., 1600UT Wall System 1

B. Acceptable Manufacturers and Products:
   1. EFCO Corporation, Xtherm 5500X
   2. Tubelite, 400TU
   3. Oldcastle Building Envelope, Reliance TC

2.02 ALUMINUM ENTRANCES

A. Aluminum Entrances: As specified in Section 08 41 13 - Aluminum Entrances and Storefronts.

2.03 MATERIALS

A. Extruded Aluminum: ASTM B221/ASTM B221M.

B. Sheet Aluminum: ASTM B209/B209M.

C. Sheet Steel: ASTM A446/A446M.

D. Steel Sections: ASTM A36/A36M; shaped to suit mullion sections.

E. Fasteners: Stainless steel.

F. Flashings: .063 inch thick aluminum finish to match curtain wall mullion sections where exposed, secured with concealed fastening method.

2.04 FINISHES

A. Dark Bronze Finish: AAMA 611, AA-M12C22A, Class I, 0.018 mm or thicker.

2.05 GLASS AND GLAZING MATERIALS

A. Glazing Materials: As specified in Section 08 81 00 - Glazing.

2.06 SEALANT MATERIALS

A. Sealant and Backing Materials: As specified in Section 07 92 00 - Joint Sealers.

2.07 ACCESSORIES

A. Fasteners: Aluminum or non-magnetic stainless steel, warranted by manufacturer to be non-corrosive and compatible with aluminum components. Avoid use of exposed fasteners. Provide matching Phillips flat-head screws for exposed fasteners.

B. Glazing Accessories: Manufacturer's standard silicone glazing gaskets and setting blocks designed specifically for specified system.

C. Cap/Sill Flashings: Aluminum, anodized finish to match curtainwall mullion sections where exposed, secured with concealed fastening method.

2.08 FABRICATION

A. Fabricate curtainwall frames allowing for minimum clearances and shim spacing around perimeter of assembly. Shop fabricate frame components where possible.

B. Rigidly fit and secure joints and corners with internal reinforcement. Make joints and connections flush, hairline, and weatherproof.

C. Develop drainage holes with moisture pattern to exterior.

D. Prepare components to receive anchor devices. Fabricate anchorage items.

E. Arrange fasteners, attachments, and jointing to ensure concealment from view.

F. Prepare components with required internal reinforcement for door hardware.

G. Finish, fabricate and shop assemble curtainwall under the responsibility of single manufacturer.

PART 3 EXECUTION

3.01 INSPECTION

A. Verify wall openings and adjoining air and vapor seal materials are ready to receive work of this Section.

B. Beginning of installation means acceptance of existing conditions.

3.02 INSTALLATION

A. Install curtainwall frames in accordance with manufacturer's instructions, or more stringent requirements indicated.

B. Use anchorage devices to securely attach frame assembly to structure.

C. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work. Install aluminum infill panels in curtainwall framing similar to glazing.

D. Apply one coat of bituminous paint to concealed aluminum and steel surfaces in contact with cementitious or dissimilar materials.

E. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

F. Install glass in accordance with Section 08 81 00, using dry method of glazing.

G. Install perimeter sealant and backing materials, in accordance with Section 07 92 00.

H. Install hardware in accordance with Section 08 71 00 - Door Hardware.

I. Adjust operating hardware. All door operation to comply with requirements of ADAAG.

3.03 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections.
   1. ASTM E1105, ASTM E283/E283M and AAMA 501.2 Water/Air testing. Contractor to assist with testing by providing safe access, water, power, chamber materials and personnel to perform the tests. If failure occurs, provide additional test assistance as needed to pa ss test at no additional cost.
   2. See Structural drawings for required wind loads and pressures to be tested.
   3. No increase in allowable rate of air infiltration or increase in the volume of water leakage, nor any decrease in the specified test pressures is permitted. Test according to AAMA 503. Test first frames installed.
   4. Coordinate testing with the requirements of Section 01 91 13.

B. Repair or remove work if test results and inspections indicate that it does not comply with specified requirements.

C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
   1. Coordinate testing with the requirements of Section 01 91 13. Re-test as required to ensure passing of specimens.

D. Aluminum-framed assemblies will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.04 CLEANING

A. Remove protective material from prefinished aluminum surfaces.

B. Wash down exposed surfaces using a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.

C. Remove excess sealant by moderate use of mineral spirits or other solvent acceptable to sealant manufacturer.

END OF SECTION

SECTION 08 71 00

DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Mechanical door hardware for the following:
      a. Swinging doors.
      b. Sliding doors.
      c. Folding doors.
      d. Site gates.
      e. Other doors to the extent indicated.
   2. Cylinders for doors specified in other Sections.
   3. Electrified door hardware.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Installation Templates: Distribute for doors, frames, and other Work specified to be factory prepared. Check Shop Drawings of other Work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
   2. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.
   3. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

B. Pre-Submittal Hardware and Keying Meeting: Prior to preparing final submittals, conduct meeting including Owner, Architect, and supplier of hardware to determine the following:
   1. Lock Function: Demonstrate function/type of each lockset scheduled and verify function at each door.
   2. Electrical Operation: Verify function of openings requiring electrified hardware.
   3. Keying: Determine keying requirements for preparation of final keying schedule.
   4. Submit letter of compliance, indicating when this meeting was held and who was in attendance, to Architect, Owner, and hardware supplier.

C. Pre-Installation Meeting: Conduct meeting at Project site to comply with requirements in Section 01 31 00 - Project Management and Coordination. Review methods and procedures related to electrified door hardware including the following:
   1. Inspect and discuss electrical roughing-in and other preparatory Work performed by other trades.
   2. Review sequence of operation for each type of electrified door hardware.
   3. Review and finalize construction schedule and verify availability of materials, installer's personnel, equipment, and facilities needed to make progress and avoid delays.
   4. Review required testing, inspecting, and certifying procedures.
   5. Record minutes of meeting, indicating when it was held and who was in attendance, and submit to Owner, Architect, and hardware supplier.

D. Keying Meeting: Conduct meeting at Project site to comply with requirements in Section 01310 - Project Management and Coordination. Incorporate keying meeting decisions into final keying schedule after reviewing door hardware keying system.

1.3 ACTION SUBMITTALS

A. Product Data: Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Details of electrified door hardware, indicating the following:
   1. Wiring Diagrams: Power, signal, and control wiring. Verify voltage with electrical engineer. Include the following:
      a. System schematic.
      b. Point-to-point wiring diagram indicating detailed interface between electrified door hardware, fire alarm, and security systems. Clarify between manufacturer-installed and field-installed wiring.
      c. Riser diagram, including electrified components, gage of wire, and wire run.
      d. Elevation of each door.
   2. Detail interface between electrified door hardware and fire alarm, access control, security and building control, system.
   3. Operation Narrative: Describe operation of doors controlled by electrified door hardware.

C. Samples for Verification: For exposed door hardware of each type, in specified finish, full size. Tag with full description for coordination with the door hardware sets. Submit Samples before, or concurrent with, submission of final door hardware sets.
   1. Sample Size: Submit minimum 2-by-4-inch plate Samples of each type of finish required, except primed finish.
   2. Full-size Samples will be returned to Contractor. Units that are acceptable and remain undamaged through submittal, review, and field comparison process may, after final check of operation, be incorporated into Work, within limitations of keying requirements.

D. Other Action Submittals:
   1. Door Hardware Sets: Prepared by or under supervision of, and signed by, Architectural Hardware Consultant (AHC), detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate final door hardware sets with doors, frames, and related Work to ensure proper size, thickness, hand, function, and finish of door hardware.
      a. Hardware schedules submitted without AHC’s signature will be rejected without review.
      b. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule." Double space entries, and number and date each page.
         1) Use same scheduling sequence, format, and door numbers indicated in Contract Documents.
      c. Content: Include the following information:
         1) Identification number, location, hand, fire rating, and material of each door and frame.
         2) Type, style, function, size, quantity, and finish of each door hardware item. Include description and function of each lockset and exit device.
         3) Complete designations of every item required for each door or opening including name and manufacturer.
         4) Fastenings and other pertinent information.
         5) Location of each door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
         6) Explanation of abbreviations, symbols, and codes contained in schedule.
         7) Mounting locations for door hardware.
         8) Door and frame sizes and materials.
         9) Description of each electrified door hardware function, including location, sequence of operation, and interface with other building control systems.
            a) Sequence of Operation: Include description of component functions that occur in the following situations: Authorized person wants to enter; authorized person wants to exit; unauthorized person wants to enter; unauthorized person wants to exit.

10) List of related door devices specified in other Sections for each door and frame.

d. Submittal Sequence: Submit final door hardware sets at earliest possible date, particularly where approval of door hardware sets must precede fabrication of other Work that is critical in Project construction schedule. Include Product Data, Samples, Shop Drawings of other Work affected by door hardware, and other information essential to coordinated review of door hardware sets.

2. Keying Schedule: Prepared by or under supervision of Architectural Hardware Consultant (AHC), detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations.
   a. Submit 1 copy to Architect for information only.

E. Special Submittal Requirements: Combine submittals of this Section with Sections listed below to ensure design intent of system/assembly is understood and can be reviewed together.
   1. Section 08 11 13 – Hollow Metal Doors and Frames.
   2. Section 08 14 16 – Flush Wood Doors.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and Architectural Hardware Consultant.

B. Product Certificates: For electrified door hardware, from the manufacturer.
   1. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.

C. Product Test Reports: For compliance with accessibility requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for door hardware on doors located in accessible routes.

D. Warranty: Special warranty specified in this Section.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of door hardware to include in maintenance manuals. Include final hardware and keying schedule.
   1. Operating and maintenance manuals: Submit 3 sets containing the following:
      a. Maintenance instructions and warranty information for each item of hardware.
      b. Catalog pages for each product.
      c. Contact information for supplier of hardware and local representatives of each product manufacturer.
      d. Parts list for each product.
      e. Copy of final hardware schedule.
      f. Copy of final wiring diagrams.
      g. Copy of final keying schedule.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish complete units of door hardware listed in group 300.0, at project completion, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Firm with 3 years experience in installation of commercial hardware similar to that required for this Project, and an employer of workers trained and approved by product manufacturers and an Architectural Hardware Consultant who is available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.
   1. Installer's responsibilities include supplying and installing door hardware and providing qualified Architectural Hardware Consultant (AHC) available during course of Work to consult with Contractor, Architect, and Owner about door hardware and keying.

2. Successfully completed not less than 5 comparable scale projects.
3. Warehousing Facilities: In Project's vicinity.
4. Scheduling Responsibility: Preparation of door hardware and keying schedules.
5. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

B. Supplier Qualifications: Recognized commercial hardware supplier that maintains and operates an office and stocking warehouse in Project area for at least 2 years and can document experience with projects of similar type and scale.
1. For door hardware, an Architectural Hardware Consultant (AHC).
2. Consulting services include overseeing scheduling, coordinating of hardware, establishing keying schedule, and being available during construction to consult with Contractor, Architect, and Owner about mechanical and electrical door hardware specified.

C. Source Limitations: Obtain each type of door hardware from a single manufacturer.
1. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.

D. Fire-Rated Door Assemblies: Where fire-rated door assemblies are indicated, provide door hardware rated for use in assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure per NFPA 252 or UL 10C, unless otherwise indicated.

E. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meet requirements of assemblies tested according to UL 1784 and installed per NFPA 105.
1. Air Leakage Rate: Maximum air leakage of 0.3 cfm per square foot at the tested pressure differential of 0.3 inch wg of water.

F. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

G. Means of Egress Doors: Latches do not require more than 15 pound-force to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.

H. Accessibility Requirements: For door hardware on doors in an accessible route, comply with U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.
1. Provide operating devices that do not require tight grasping, pinching, or twisting of wrist and that operate with a force of not more than 5 pound-force.
2. Comply with the following maximum opening-force requirements:
   a. Interior, Non-Fire-Rated Hinged Doors: 5 pound-force applied perpendicular to door.
   b. Sliding or Folding Doors: 5 pound-force applied parallel to door at latch.
   c. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch high.
4. Adjust door closer sweep periods so that, from an open position of 70 degrees, door will take at least 3 seconds to move to a point 3 inches from the latch, measured to leading edge of door.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.

B. Tag each item or package separately with identification related to the final door hardware sets, and include basic installation instructions, templates, and necessary fasteners with each item or package.

C. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

D. Deliver permanent keys and cores to Owner by registered mail or overnight package service.

1.9 WARRANTY

A. Warrant materials and workmanship against defects including coverage for operation of specified hardware, after completion and final acceptance of Work.
   1. Repair defects from faulty materials or workmanship developed during guarantee period, or replace with new materials, at no expense to Owner.
   2. Replace shortages and incorrect items with correct materials at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. Provide door hardware for each door as scheduled in Part 3 Door Hardware Schedule Article and on Drawings to comply with requirements in this Section.
   1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and named manufacturers'
   2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.

B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 Door Hardware Schedule Article. Products are identified by using door hardware designations, as follows:
   1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for purpose of establishing minimum requirements. Manufacturers' names are abbreviated in Part 3 Door Hardware Schedule Article.
   2. References to BHMA Designations: Where products are not specified by name, provide products complying with BHMA designations and requirements for description, quality, and function.

2.2 HINGES

A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.]
   1. Manufacturers: Subject to compliance with requirements, provide specified products by one of the following:
      a. Bommer Industries, Inc.
      b. Hager Companies.
      c. HB Ives (Div of Ingersoll Rand)
      d. McKinney Products Company; an ASSA ABLOY Group company.
      e. Stanley Commercial Hardware; Div. of The Stanley Works.

B. Butts and Hinges: BHMA A156.1. Listed under Category A in BHMA's "Certified Product Directory."

C. Hinge Sizes: Provide the following hinges in widths sufficient to minimally clear trim.

Thickness	Size
2-1/4 inch Doors	5 inch by 5 inch
1-3/4 inch Doors	4-1/2 inch by 4-1/2 inch
1-3/8 inch Doors	3-1/3 inch by 3-1/2 inch

D. Furnish butt hinges for each door leaf as follows:
   1. 1 pair per leaf for openings through 60 inches high.
   2. 1 additional hinge per leaf for each additional 30 inches in height or fractions thereof.
   3. 1 additional hinge for doors 3’-4” wide to 4’-0” wide.
   4. 1 additional hinge for exterior and vestibule doors.

E. Applications:
1. Exterior out swinging doors: Type 4 x NRP.
2. Exterior in swinging doors and vestibule doors: Type 3.
3. Interior doors over 36 inches in width: Type 3.
4. Interior doors 36 inches or less: Type 1.
5. Exterior and reversed beveled interior lockable doors: Non-removable loose pin (NRP) hinges.

F. Acceptable Manufacturers and Products:

Type	Bommer	Hager	Ives	McKinney	Stanley
Type 1	BB5000	BB1279	5BB1	TA2714	FBB179
Type 2	BB5002	BB1191	5BB1	TA2314	FBB191
Type 3	BB5004	BB1168	5BB1HW	T4B3786	FBB168
Type 4	BB5006	BB1199	5BB1HW	T4B3386	FBB199

2.3 CONTINUOUS HINGES

A. Continuous Hinges: BHMA A156.26; minimum 0.120 inch thick, hinge leaves with minimum overall width of 4 inches; fabricated to full height of door and frame and to template screw locations; with components finished after milling and drilling are complete.

B. Continuous, Gear-Type Hinges: Extruded-aluminum, pinless, geared hinge leaves joined by continuous extruded-aluminum channel cap; with concealed, self-lubricating thrust bearings.

	McKinney	Hager	Ives	Stanley	Select	Pemko
SS Pin and Barrel	MCK-FM300	790-900	700	651	SL300	
Continuous, Gear-Type Hinges	MCK-12HD	780-112HD	112HD	661HD	SL-11HD	
Continuous, Safety Hinge						_FM_SF

C. Prep hinges for electric power transfers and automatic door bottoms where specified.

D. Provide 1 of 2 models above of continuous hinges as appropriate for type, inset, and thickness of door where specified. Coordinate hinge types with door supplier.

2.4 ELECTRIC POWER TANSFER

A. Electrified Functions for Hinges: Comply with the following:
1. Manufacturers: Subject to compliance with requirements, provide specified products by one of the following:
a. Securitron Corporation; an ASSA ABLOY Group company: CEPT-10.
b. Von Duprin; an Ingersoll-Rand Company: EPT-2/EPT-10.

2.5 MECHANICAL LOCKS AND LATCHES

A. Lock Functions: As indicated in door hardware schedule.

B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:
1. Bored Locks: Minimum 1/2 inch latchbolt throw.
2. Mortise Locks: Minimum 3/4 inch latchbolt throw.
3. Deadbolts: Minimum 1 inch bolt throw.

C. Lock Backset: 2-3/4 inch, with deadlocking feature unless otherwise indicated.

D. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.
1. Flat-Lip Strikes: For locks with 3-piece antifriction latchbolts, as recommended by manufacturer.
2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.

3. Aluminum-Frame Strike Box: Manufacturer's special strike box fabricated for aluminum framing.

E. Bored Locks – Heavy Duty Type: BHMA A156.2; Grade 1; Series 4000.
1. Manufacturers: Subject to compliance with requirements, provide specified products by one of the following:
a. Base Bid: Schlage, No Substitutions
b. Alternate pricing will be accepted from the following manufacturers. Owner to accept or decline alternate pricing.
1) Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company.
2) SARGENT Manufacturing Company; an ASSA ABLOY Group company.
3) Yale Commercial Locks; an ASSA ABLOY Group company.
4) Falcon Locks; an Allegion Company.
2. Where listed, provide electrified locks that comply with above requirements and that incorporate self-contained integral continuous duty solenoid. Provide 24V, either AC or DC as required in Fail-Safe or Fail-Secure function as listed in hardware sets. Provide electrified locks from same manufacturer as mechanical locks.
3. Acceptable Manufacturers and Products:

	Corbin-Russwin	Sargent	Schlage	Yale	Falcon
Lock	CL3300	FW-10-Line	L- ND	5400LN	T-Series
Trim	NZD	LL	RHO	AU	D - Dane

F. Mortise Locks: BHMA A156.13; Operational Grade 1; stamped steel case with steel or brass parts; Series 1000.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Base Bid: Schlage, No Substitutions.
b. Alternate pricing will be accepted from the following manufacturers. Owner to accept or decline alternate pricing.
1) Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company.
2) SARGENT Manufacturing Company; an ASSA ABLOY Group company.
3) Yale Commercial Locks; an ASSA ABLOY Group company.
4) Falcon Locks; an Allegion company.
2. Provide locks with reversible handing of lock without disassembly of lock.
3. Where listed, provide electrified locks that comply with above requirements and that incorporate self-contained integral continuous duty solenoid. Provide 24V, either AC or DC as required in Fail-Safe or Fail-Secure function as listed in hardware sets. Provide electrified locks from same manufacturer as mechanical locks.

	Corbin-Russwin	Sargent	Schlage	Yale	Falcon
Lock	ML2000	8200	L-9000	8800FL	MA-Series
Trim-Sect.	NSA	LNL	06A	AUR	DG

2.6 STAND ALONE ACCESS CONTROL LOCKS

A. Provide security-locking system that is stand alone battery operated ANSI/BHMA Grade One locks. All locks shall have an interchangeable core cylinder bypass. All levers shall match mechanical locks and trim. Provide units with a weather seal when used in areas of moisture and high humidity. All readers shall be equipped with non-volatile memory. Provide locks capable of minimum of 100 user capacity.
1. Manufacturers: Subject to compliance with requirements, provide specified products by one of the following:
a. Alarm Lock DL2700
b. Corbin-Russwin CL33800 series.
c. Sargent 10G77Lk
d. Schlage CO-100 Series
e. Yale E5496LN

2.7 MANUAL FLUSH BOLTS

A. Manual Flush Bolts: BHMA A156.16; Grade 1; minimum 3/4 inch throw; designed for use in metal doors and mortised into door edge for all doors. Coordinate with Wood Door Manufacturers.
   1. Manufacturers: Subject to compliance with requirements, provide specified products by one of the following:
      a. Door Controls International, Inc.
      b. Hager Companies.
      c. IVES Hardware; an Ingersoll-Rand company.
      d. McKinney Products Company; an ASSA ABLOY Group company.
      e. Trimco.

2.8 AUTOMATIC AND SELF-LATCHING FLUSH BOLTS

A. Automatic and Self-Latching Flush Bolts: BHMA A156.16; Grade 1; minimum 3/4 inch throw; designed for use in metal doors and mortised into door edge for all doors. Coordinate with Wood Door Manufacturers.
   1. Manufacturers: Subject to compliance with requirements, provide specified products by one of the following:
      a. Door Controls International, Inc.
      b. Hager Companies.
      c. IVES Hardware; an Ingersoll-Rand company.
      d. McKinney Products Company; an ASSA ABLOY Group company.
      e. Rockwood Architectural Hardware; an ASSA ABLOY Group company.
      f. Trimco.

	DCI	Hager	Ives	McKinney	Rockwood	Trimco
Manual-Metal Door	780F	282D	FB458	FB01M	555	3917
Auto-Metal Door	842	292D	FB31P	FB06M	1842	3810
Dust Proof Strike	82	280X	DP2	DPS3	570	3911

2.9 EXIT DEVICES AND AUXILIARY ITEMS

A. Exit Devices and Auxiliary Items: BHMA A156.3, Grade 1.
   1. Manufacturers: Subject to compliance with requirements, provide specified products by one of the following:
      a. Base Bid: Von Duprin, No Substitutions.
      b. Alternate pricing will be accepted from the following manufacturers. Owner to accept or decline alternate pricing.
         1) Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company.
         2) SARGENT Manufacturing Company; an ASSA ABLOY Group company.
         3) Yale Commercial Locks; an ASSA ABLOY Group company.
         4) Falcon Exit Devices; an Allegion Company
   2. Provide exit devices by single manufacturer.
   3. Provide vandal resistant outside trim to discourage abuse when door is locked. Provide trim with lever design to match locks.
   4. Provide device where noted with a photoluminescent coating which will produce visible EXIT signage in darkness or low lit areas similar to Yale “LUM”.
   5. Provide cylinder dogging on non-rated devices.
   6. Provide devices with a heavy duty flush end cap.
   7. Removable Mullions: Keyed.
   8. When Electrified functions are specified, provide manufacturer’s recommended power supply that is filtered and regulated; and listed and labeled for use with fire alarm systems, with power sufficient to operate electrified function specified.

	Corbin-Russwin	Von Duprin	Yale	Sargent	Falcon
Wide Stile	ED5000S-M110	70 Series	7100-ECK Series	GL-43-80 Series	25-Series
Active Trim	900 Series	996L	600 series	740ET	510L

B. Value Series Alarmed Exits only as specified in hardware groups.
   1. Exit Device and Auxiliary Items: BHMA A156.3, Grade 1.
      a. Manufacturers: Subject to compliance with requirements, provide specified products by the following manufacturer:
         1) Detex.
      b. Provide exit devices by single manufacturer.
      c. Provide devices with weatherized exit alarm that allows cylinder dogging. Touchpad shall be RED with the following silk screened on the face “Emergency Exit Only Alarm will Sound”.
      d. Removable Mullions: When used in conjunction with valued series alarmed exits, provide Yale M300 aluminum mullion including mullion stabilizer kit.

	Detex
Wide Stile	V40xEBxW

2.10 ELECTRIC STRIKES

A. Comply with ANSI/BHMA A156.5 requirements for Grade 1.

B. Provide electric strikes UL listed for fire rated doors and frames where required.

C. Provide corrosion-resistant case and working parts

D. Provide 4 7/8 inch face plates for use with mortise cylindrical locks.

E. Provide fail secure strikes (locked when power is off) for labeled doors.

F. Provide electric strikes that comply with above requirements with plug connector. Provide wiring harness as listed below. Provide 24VDC with function as listed in hardware sets.

G. Acceptable Manufacturers and Products:

	Folger-Adam	HES	Von Duprin
Cylindrical Lock	700 Series	1006 Series	6211

2.11 MAGNETIC LOCKS

A. Acceptable Manufacturers and respective catalog numbers:

	Schlage Electronics
Shear Lock	320M Series

B. Provide magnetic locks as specified, complete with mounting brackets and fasteners appropriate to the application. Shear Locks shall have a minimum of 500 lbs holding force.

C. Provide magnetic locks with integral magnetic bond sensor, time delay (1-90 Seconds) for re-locking.

D. Provide regulated and filtered power supplies for magnetic locks by the same manufacturer.

2.12 LOCK CYLINDERS

A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver.
   1. Manufacturer: Same manufacturer as for locking devices.
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Base Bid: Schlage, No Substitutions.

b. Alternate pricing will be accepted from the following manufacturers. Owner to accept of decline alternate pricing.
   1) Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company.
   2) SARGENT Manufacturing Company; an ASSA ABLOY Group company.
   3) Yale Commercial Locks; an ASSA ABLOY Group company.

B. Standard Lock Cylinders: BHMA A156.5; Grade 1; permanent cores that are 6-Pin Utility Patented interchangeable; face finished to match lockset.

C. Construction Cores: Provide temporary keyed construction cores and keys for all doors during the construction period. Construction control and operating keys and cores shall not be part of the Owner's permanent keying system or furnished on the same keyway (or key section) as the Owner's permanent keying system. .

2.13 KEYING

A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A. Incorporate decisions made in keying conference.
1. Base Bid: Schlage, No Substitutions.
2. Alternate pricing will be accepted from the following manufacturers. Owner to accept or decline alternate pricing.
3. Acceptable Manufacturers and Products:

	Corbin-Russwin	Sargent	Schlage	Yale
Utility Patented Keyway	Pyramid	Signature	Classic Primus	KeyMark

B. Keys: Nickel silver factory-cut keys furnished with large bow.
1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:
   a. Notation: "DO NOT DUPLICATE."
2. Quantity: In addition to 1 extra key blank for each lock, provide the following:
   a. Change Keys: 3 each per cylinder.
   b. Control Keys: 2 each.
   c. Extra Key Blanks: 50 each.
   d. Master Keys: 6 each per master key group.
   e. Construction Control Keys: 2 each.
   f. Construction Keys: 15 each.
3. Ship permanent keys, cores, master keys, change keys, and additional key blanks, permanent control keys, and bitting list indicating bitting generated for this Project, directly to Owner, via registered mail. Shipment shall be complete, with keys enveloped in sets and tagged with key set numbers (with proper code numbers and factory file or folio number). Do not pack permanent keys and cores with locks. If permanent keys, cores, or both are sent anywhere other than previously stated, replace at no additional cost to Owner.
   a. Forward Owner's Key System Registration Certificates, which shall accompany each procurement during construction period, to hardware supplier.

2.14 KEY CONTROL SYSTEM

A. Key Control Cabinet: Provide BHMA A156.5, Grade 1; metal cabinet with baked-enamel finish; containing key-holding hooks, labels, 2 sets of key tags with self-locking key holders, key-gathering envelopes, and temporary and permanent markers; with key capacity of 150 percent of number of locks.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. American Key Boxes and Cabinets.
   b. GE Security, Inc.
   c. HPC, Inc.
   d. Lund Equipment Co., Inc.
   e. MMF Industries.

f. Tri Palm International.

2. Wall-Mounted Cabinet: Cabinet with hinged-panel door equipped with key-holding panels and pin-tumbler cylinder door lock.

2.15 ACCESSORIES FOR PAIRS OF DOORS

A. Coordinators: BHMA A156.3; consisting of active-leaf, hold-open lever and inactive-leaf release trigger; fabricated from steel with nylon-coated strike plates; with built-in, adjustable safety release and with internal override.

1. Manufacturers: Subject to compliance with requirements, provide specified products by one of the following:
   a. Door Controls International (DCI).
   b. Hager Companies.
   c. Ives Hardware; an Ingersoll-Rand Company.
   d. Rockwood Manufacturing Company; an ASSA ABLOY Group company.
   e. Trimco.

	DCI	Hager	Ives	Rockwood	Trimco
Bar Type Coordinator	600 Series	297D	COR	1600	3094

2.16 SURFACE CLOSERS

A. Surface Closers: BHMA A156.4 Grade 1; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

1. Manufacturers: Subject to compliance with requirements, provide specified products by one of the following:
   a. Base Bid: LCN, No Substitutions
   b. Alternate pricing will be accepted from the following manufacturers. Owner to accept or decline alternate pricing.
      1) Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company.
      2) Falcon Closers, an Allegion Company.
      3) SARGENT Manufacturing Company; an ASSA ABLOY Group company.
2. Fully adjustable type, with complete spring power adjustment, sizes 1 through 6.
3. Provide closers with swing, latch, and back check features.
4. Provide parallel rigid arm for closers mounted on push side of opening.
5. Coordinate with door supplier to provide proper blocking for surface mounting. Use of through-bolts is not acceptable.
6. Where closers are indicated to be closer/stops provide heavy-duty arms with means of positive stop. For closer/holders, provide heavy-duty units with additional built-in mechanical holder assembly. Manually select holder to off/on position.
7. Provide meeting requirements to physically handicapped, provide units complying with ANSI/ICC A117.1 provisions for door opening force closing force.
8. Install closers using only manufacturer-furnished template machine screws for metal doors and manufacturer -furnished wood screws for wood doors.
   a. Use of self-drilling or self-tapping fasteners is not allowed.
9. Accessories: Mounting brackets, drop plates, special shoes required by door and frames conditions.
10. Acceptable Products: Subject to compliance with requirements, provide one of the following:

	Corbin-Russwin	LCN	Sargent	Falcon
Heavy Duty-	DC8000A10/DC8000A3	4011/4111	281/281P-10	SC70 Series

2.17 AUTOMATIC DOOR OPERATORS

A. Acceptable manufacturers and respective catalog numbers:

	Horton	LCN	Norton	Stanley
Electro-Hydraulic Operator	4000LE	4640	5900	Magic Force

B. Where low kinetic energy, as defined by ANSI/BHMA Standard A156.19, power operators are indicated for doors required to be accessible to the disabled, provide electrically powered operators complying with the ADA for opening force and time to close standards.

C. The closing action shall be controlled by modern type cast iron door closer cylinder filled with a flat viscosity fluid, stable from +120F to -30F that would require no seasonal adjustments. The closer shall have field adjustable spring power; have two independent closing speed adjustment valves, and hydraulic back-check.

D. Full closing force shall be provided when the power or assist cycle ends.

E. All power operator systems shall include the following features and functions:

1. Provisions for separate conduits to carry high and low voltage wiring in compliance with the National Electrical Code, section 725-31.
2. The operator will be designed with an electronically controlled mechanical clutching mechanism to prevent damage to the operator if the system is actuated while the door is latched or if the door is forced closed during the opening cycle.
3. All covers, mounting plates and arm systems shall be powder coated and successfully pass a minimum of 100 hours testing as outlined in ANSI/BHMA Standard A156.18.
4. UL listed for use on labeled doors.
5. All operators shall be non-handed with spring power over a range of at least four sizes; either 1 through 4 or 2 through 5.
6. The power operator shall incorporate microprocessor controlled digital controls including: factory default memory settings, on-board diagnostics, non-volital memory, and intergrated delay and relay for controlling door release devices.
7. Provisions in the control box or module shall provide control {inputs and outputs) for; electric strike delay, auxiliary contacts, sequential operation, fire alarms systems, actuators, swing side sensors, and stop side sensors.
8. Wall mounted actuators shall consist of a 4-1/2 inch diameter stainless steel touch plate with a blue filled handicapped symbol. Switches shall be weather resistant and mount on a single gang electrical box furnished by Division 16.

F. All electrically powered operators shall include the following features or functions:

1. When an obstruction or resistance to the opening swing is encountered, the operator will pause at that point, then attempt to continue opening the door. If the obstruction or resistance remains, the operator will again pause the door.
2. Easily accessible main power and maintain hold open switches will be provided on the operator.
3. An electronically controlled clutch to provide adjustable opening force.
4. A microprocessor to control all motor and clutch functions.
5. An on-board power supply capable of delivering both 12V and 24V outputs up to a maximum of 1.0 ampere combined load.
6. All input and output power wiring shall be protected by slow blow fuses. These fuses shall be easily replaceable without special tools or component replacement.
7. If electrical failure occurs, the unit shall operate as a standard door closer.

G. Power Operators shall be warranted by the manufacture to be free from defects in material and workmanship for a period of two years.

H. Activation and Safety Devices.

1. General: Provide activation devices per BHMA standards, for condition of exposure and for long-term, maintenance-free operation under normal traffic load for type of occupancy indicated. Coordinate activation and safety devices with door operation and door operator mechanisms.
2. Push-Plate Switch: Momentary-contact door control switch with flat push-plate actuator with contrasting-colored, engraved message and weather resistant gasket for exterior openings.
    a. Configuration: Round push plate with 4-1/2-inch (100-by-100-mm) with surface mount box.
        1) Mounting: Surface mounted as indicated on Drawings.
    b. Push-Plate Material: Stainless steel.
    c. Message: International symbol of accessibility and "Push to Open."

d. Products similar to Wikk N4RS x4R-3

3. Electrical Interlocks: Unless units are equipped with self-protecting devices or circuits, provide electrical interlocks to prevent activation of operator when door is locked, latched, or bolted.

2.18 MECHANICAL STOPS AND HOLDERS

A. Wall- Stops: BHMA A156.16; polished cast brass, bronze, or aluminum base metal

1. Manufacturers: Where indicated in doors and hardware schedules, provide specified products from one of the following:
   a. Door Controls International, Inc.
   b. Hager Companies.
   c. IVES Hardware; an Ingersoll-Rand company.
   d. McKinney; an ASSA ABLOY Group Company
   e. Rockwood Manufacturing Company; an ASSA ABLOY Group Company.
   f. Trimco.
2. Install surface-mounted stops and holders using only manufacturer supplied template machine screws for metal doors and manufacturer supplied wood screws for wood doors. Use of self-drilling or self-tapping fasteners is not allowed.
3. Coordinate with door supplier to provide proper blocking for surface mounting. Use of through-bolts is not acceptable.

B. Wall Stops:

	DCI	Hager	Ives	Rockwood	Trimco
Convex	3210	236W	WS406CVX	407	1270CX
Concave	3211	232W	WS406CCV	410	1270CV
Extended	3260X	255W	WS11	518	1208

2.19 ELECTROMAGNETIC STOPS AND HOLDERS

A. Electromagnetic Door Holders: BHMA A156.15, Grade 1; wall-mounted or floor-mounted electromagnetic units with strike plate attached to swinging door; coordinated with fire detectors and interface with fire alarm system for labeled fire-rated door assemblies.

1. Acceptable Products: Subject to compliance with requirements, provide one of the following:

	LCN	Rixson	Sargent
Flush-Mount	SEM1900	FM998	1561

2. UL listed, triple voltage, field-selectable units. Provide extension pieces as required to meet wall conditions.

2.20 OVERHEAD STOPS AND HOLDERS

A. Overhead Stops and Holders: BHMA A156.8.

1. Acceptable Products: Subject to compliance with requirements, provide one of the following:

	Glynn-Johnson	Rixson	Sargent
Heavy Duty Concealed	GJ-100	6-Series	690
Heavy Duty Surface	GJ-90	9-Series	590
Standard Duty Surface	GJ-450	10-Series	1540

2. Provide overhead stop for doors that are capable of swinging more than 145 degrees before striking wall and where door strikes fixed object such as sink, cabinet, and similar obstructions.

2.21 DOOR GASKETING

A. Door Gasketing: BHMA A156.22; air leakage not to exceed 0.50 cfm per foot of crack length for gasketing other than for smoke control, as tested per ASTM E283; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.

1. Basis of Design Product: Subject to compliance with requirements, provide MCKS88 Silicone Seal by McKinney Products Company or comparable product by one of the following:

a. McKinney; an ASSA ABLOY Group company
b. National Guard Products.
c. Pemko Manufacturing Co.; an ASSA ABLOY Group company.
d. Reese Enterprises, Inc.
e. Zero Manufacturing

2. Coordinate with door manufacturer. Comply with UL10C for intumescent fire and smoke material.
3. Provide smoke gasket at each labeled opening similar to McKinney MCKS88.

2.22 THRESHOLDS

A. Thresholds: BHMA A156.21; full saddle, fabricated to full width of opening indicated.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. McKinney Products Company; an ASSA ABLOY Group company
b. National Guard Products.
c. Pemko Manufacturing Co.; an ASSA ABLOY Group company.
d. Reese Enterprises, Inc.

	McKinney	National Guard	Pemko	Reese	Zero
Thermal Break	MCK252 x 3FG	8425	252 x 3FG	S471A	625A

2.23 SWEEPS:

A. Hollow Metal and Wood Doors:
1. Acceptable Manufacturers and Products:

	McKinney	National Guard	Pemko	Reese	Zero
Neoprene	MCK315-N	200N	315-N	323	39A
with Rain Drip	MCK3452	C627	3452NB	354	8198A

B. Aluminum doors:
1. Acceptable Manufacturers and Products:

	Special-Lite
Adjustable sweep	SL-301

2.24 WEATHERSTRIP

A. Acceptable Manufacturers and Products:

	McKinney	National Guard	Pemko	Reese	Zero
Polyprene	MCK303PK	135NA	303PK	815	8303

2.25 AUTOMATIC DOOR BOTTOMS

A. Provide units with a light-spring action which reduces the operating force to 3-5 pounds required for actuation.
1. Pemko No. 4131 Series specified.
2. Provide Pemko “RL” Sponge neoprene for units sealing against hard surfaces. Semi-mortised on non-rated openings.
3. Provide Pemko “NBL” aluminum bar with nylon brush for units sealing over carpet. Semi-mortised on non-rated openings..
4. Provide Pemko 420PKL for use in hollow metal and aluminum doors.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. McKinney Products Company; an ASSA ABLOY Group company
2. National Guard Products.
3. Pemko Manufacturing Co.; an ASSA ABLOY Group company.
4. Reese Enterprises, Inc.

5. Zero Manufacturing

2.26 METAL PROTECTIVE TRIM UNITS

A. Metal Protective Trim Units: BHMA A156.6; fabricated from 0.050 inch thick stainless steel; with manufacturer's standard machine or self-tapping screw fasteners.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Burns Manufacturing Incorporated.
      b. Hager Companies.
      c. Hiawatha, Inc.
      d. Ives; an Ingersoll Rand Company
      e. McKinney Products Company; an ASSA ABLOY Group company
      f. Rockwood Manufacturing Company.
      g. Trimco.

B. Push Plates: Beveled edges (B4E).
   1. Size: 8 inch by 16 inch. Provide 4 inch by 16 inch where 8 inch by 16 inch is not applicable due to door conditions.
   2. Acceptable Manufacturers and Products:

	Burns	Hager	Hiawatha	Ives	Rockwood	Trimco
8 inch x 16 inch	57	30S	200K	8200	70F	1001-11
4 inch x 16 inch	54	30S	200F	8200	70C	1001-3

C. Door Pulls: 1-1/4 inch round material, 18 inch screw centers, and 3-1/4 inch total projection with concealed screw mounting wherever through bolt attachment would leave an exposed screw. Provide reinforcement for hollow metal doors.

Burns	Hager	Hiawatha	McKinney	Rockwood	Trimco
M39G	23Q	HG122	OP9017	RM202	1191-5J

D. Pool Area Pulls: 1-1/8 inch round nylon material 14-3/16 inch x 6-7/8 inch.
   1. Acceptable Manufacturers and Products:
      a. Hafele HEWI 114.23.590 BTB Mount

E. Push/Pull Bars: 1-1/4 inch round material, pull with 12 inch screw centers, and 3-1/4 inch total projection
   1. Push bar 3 inches less than door width.
   2. Provide back-to-back mounting with top of pull and lock side of push bar. Provide decorative through-bolt at hinge stile and bottom of pull.
   3. Provide heavy-duty concealed fasteners with dual shoulder-mount set screws at mounting locations. Use of through-bolts is not acceptable.
   4. Coordinate with door supplier to provide proper blocking for mounting.

Burns	Hiawatha	McKinney	Rockwood	Trimco
M422 x M396D	HG111 x HG113	PB820-OP9017	RM251	1747-1

F. Push Bars: 1-1/4 inch round material, 3 inches less than door width. Provide decorative through-bolt.

Burns	Hiawatha	McKinney	Rockwood	Trimco
M422	HG111	PB820	RM350	1745

G. Kick Plates: Beveled edges (B4E).
   1. Widths: 2 inches less than door width.
   2. Height: 12 inches or 1/2 inch less than height of bottom rail, whichever is less.

H. Armor Plates: Beveled edges (B4E).
   1. Widths: 2 inches less than door width.
   2. Height: 42 inches, and complying with door conditions.

3. Notch for surface hardware.
4. Where indicated for fire-rated doors, provide armor plates that are labeled and installed per listings.

I. Door Edge Guards: Stainless steel, 42 inches high, 0.0478 inch thick unless otherwise specified in "Finishes" or in hardware groups. Notch for hinges.
1. Surface-applied, for single acting doors. Delete if on hollow metal doors.

J. Latch Protection Plates: Stainless steel, 3 inches wide by 11 inches high, 0.0478 inch thick unless otherwise specified in "Finishes" or in hardware groups.

K. Trim Protection Bars: Stainless steel, 14 inch center-to-center with 3-1/4 inch projection, 3/8 inch thickness.

McKinney	Rockwood
TPB05	R115LBP

2.27 AUXILIARY DOOR HARDWARE

A. Clothes Hooks:
1. Acceptable products of the following manufacturers:

Don-Jo	Rockwood	Ives
302	796	582

B. Strip Curtain:
1. Type: PVC
2. Width: See Drawings.
3. Height: 96" (VIF).
4. Hardware: Galvanized Steel Hardware, Industrial Heavy Duty, Pre-Studded.
5. Strip Width: 12" (66% overlap).
6. Gauge: 0.12
7. Color: Clear

2.28 FABRICATION

A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rated labels and as otherwise approved by Architect.
1. Manufacturer's identification is permitted on rim of lock cylinders only.

B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.

C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.
1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is only means of securely attaching door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
2. Fire-Rated Applications:
a. Wood or Machine Screws: For the following:
1) Hinges mortised to doors or frames; Use threaded-to-head wood screws for wood doors.

2) Strike plates to frames.
3) Closers to doors and frames.

b. Steel Through Bolts: For the following unless door blocking is provided:
1) Surface hinges to doors.
2) Closers to doors and frames.
3) Surface-mounted exit devices.

3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
4. Fasteners for Wood Doors: Comply with requirements in DHI WDHS.2, "Recommended Fasteners for Wood Doors."
5. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.29 ELECTROMECHANICAL HARDWARE

A. The electrical products contained within this specification represent a complete engineered system. If alternate electrical products are submitted, it is the responsibility of the supplier to bear the cost of providing a complete and working system including re-engineering of electrical diagrams and system layout, as well as power supplies, power transfers and all required electrical components. Coordinate with electrical engineer and electrician to ensure that line voltage and low voltage wiring is coordinated to provide a complete and working system.

B. For each item of electrified hardware specified, provide standardized Molex plug connectors to accommodate up to twelve (12) wires. Molex plug connectors shall plug directly into through-door wiring harnesses, frame wiring harnesses to power supplies.
1. If plug connectors are not available, coordinate installation and hook-up of hardware with a company that is licensed by the Local Electricity Board. Hinges shall be UL fire tested and listed for labeled doors up to and including Class “A”.

C. Where Electrified functions are specified, provide manufacturer’s recommended power supply that is filtered and regulated; and listed and labeled for use with fire alarm systems, with power sufficient to operate electrified function specified.

D. Electrical: Electrical boxes in walls, electrical service, conductors and final connections provided under Division 16:

E. Electro-Lynx Cables: McKinney Listed for use with Corbin Russwin, Sargent

2.30 FINISHES

A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.

B. Protect mechanical finishes on exposed surfaces from damage by applying strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within 1/2 of range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within range of approved Samples and are assembled or installed to minimize contrast.

Exposed Metal Finishes:	BHMA 613 / US10B = Oil Rubbed Bronze over nickel, over brass or bronze base metal. BHMA 643e = Dark Bronze power coated over nickel, over steel base metal. BHMA 614 = Oxidized Satin Bronze over bronze base metal. BHMA 630 / US32D = Satin Stainless Steel, over stainless-steel base material.
Hinges-Exterior:	614 – Oxidized Bronze
Hinges-Interior:	641 – Oxidized Bronze
Continuous Gear Hinges	710 / 313AN – Anodized Duranodic

Continuous Pin & Barrel	710 / 313AN – Dark Bronze Anodized
Locksets:	643e – Aged Bronze Clear Coated
Closers:	695 - Dark Bronze powder coat or painted over any base material.
Exit Devices:	710 / 313AN – Anodized Duranodic
Pushes, Pulls, Kick Plates:	695 – Dark Bronze powder coat or painted over any base material.
Armor Plates:	695 – Dark Bronze powder coat or painted over any base material.
Door Edge Guards:	695 – Dark Bronze powder coat or painted over any base material.
Overhead Stops & Holders:	SP313 – Dark Bronze powder coat
Door Stops:	643e – Aged Bronze
Thresholds:	719 / AL – Mill finish aluminum
Weatherstrip:	DKBRZ - Dark Bronze Anodized
Sweep Strips:	DKBRZ – Dark Bronze Anodized
Automatic Door Bottoms:	
(Concealed)	DKBRZ – Dark Bronze Anodized
(Semi-Mortised)	DKBRZ – Dark Bronze Anodized
Rain Drips:	DKBRZ – Dark Bronze Anodized
Miscellaneous Items:	613 / US10B– Oil Rubbed Bronze

1. Hardware on aluminum doors shall match finish of doors and frames.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and frames, with installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Hollow Metal Doors and Frames: For surface applied door hardware, drill and tap doors and frames per ANSI/SDI A250.6.

B. Wood Doors: Comply with DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."

3.3 INSTALLATION

A. Mounting Heights: Mount door hardware units at heights indicated as follows unless otherwise indicated or required to comply with governing regulations.
   1. Hollow Metal Doors and Frames: ANSI/SDI A250.8.
   2. Custom Hollow Metal Doors and Frames: HMMA 831.
   3. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."

B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 09 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

C. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than number recommended by manufacturer for application indicated or 1 hinge for every 30 inches of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

D. Intermediate Offset Pivots: Where offset pivots are indicated, provide intermediate offset pivots in quantities indicated in door hardware schedule but not fewer than 1 intermediate offset pivot per door and 1 additional intermediate offset pivot for every 30 inches of door height greater than 90 inches.

E. Lock Cylinders: Install construction cores to secure building and areas during construction period.
1. Replace construction cores with permanent cores as indicated in keying schedule.
2. Furnish permanent cores to Owner for installation.

F. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.

G. Boxed Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings. Verify location with Architect.
1. Configuration: Provide one manufacturer's power supply for each door opening, with power sufficient to operate locks.
a. Verify voltage requirements with electrical engineer, or Architect.
2. Configuration: Provide least number of power supplies required to adequately serve doors with electrified door hardware.

H. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Section 07920 - Joint Sealants.

I. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.

J. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

K. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

L. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.4 FIELD QUALITY CONTROL

A. Independent Architectural Hardware Consultant: Owner will engage qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.
1. Independent Architectural Hardware Consultant will inspect door hardware and state in each report whether installed Work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

3.5 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
1. Spring Hinges: Adjust to achieve positive latching when door is allowed to close freely from an open position of 30 degrees.
2. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.

3. Door Closers: Unless otherwise required by authorities having jurisdiction, adjust sweep period so that, from an open position of 70 degrees, door will take at least 3 seconds to move to a point 3 inches from latch, measured to leading edge of door.

B. Occupancy Adjustment: Approximately 6 months after date of Substantial Completion, schedule installer's architectural hardware consultant to examine and readjust, including adjusting operating forces, each item of door hardware as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.6 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items as necessary to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.7 DEMONSTRATION

A. Engage factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes. Refer to Section 017900 - Demonstration and Training.

3.8 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

B. Maintenance Service: Beginning at Substantial Completion, provide 6 months' full maintenance by skilled employees of door hardware installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door hardware operation. Provide parts and supplies same as those used in manufacture and installation of original products.

3.9 DOOR HARDWARE SCHEDULE- REFER TO DRAWINGS

137966 OPT0440775 VERSION 2

HW SET: 001

QTY		DESCRIPTION	CATALOG NUMBER	MFR
	EA	ALL HARDWARE BY	DOOR SUPPLIER	

HW SET: 002A

QTY		DESCRIPTION	CATALOG NUMBER	MFR
1	EA	CYLINDER	(VERIFY TYPE)	SCH

HW SET: 010

QTY		DESCRIPTION	CATALOG NUMBER	MFR
	EA	HINGE	AS REQUIRED	IVE
1	EA	PASSAGE SET	ND10S	SCH
1	EA	WALL STOP	WS406	IVE

FUNCTION: ND10 (F01) PASSAGE LATCH
BOTH LEVERS ALWAYS UNLOCKED.

HW SET: 012S97

QTY		DESCRIPTION	CATALOG NUMBER	MFR
1	EA	CONT. HINGE	112HD	IVE
1	EA	ENTRANCE/OFFICE LOCK	ND50	SCH
1	EA	WALL STOP	WS406	IVE
1	EA	BULB TYPE WTHR STRIP	BY DR/FR SUPPLIER	
1	EA	DOOR BOTTOM	5VA	NGP
1	EA	COAT AND HAT HOOK	582	IVE

FUNCTION: ND50 (F82) ENTRANCE/OFFICE LOCK
PUSH-BUTTON LOCKING. PUSH-BUTTON LOCKS OUTSIDE LEVER UNTIL UNLOCKED WITH KEY OR BY TURNING INSIDE LEVER.

NOTE: PROVIDE 613 FINISH AT ALL POOL AREA DOORS.

HW SET: 012S98

QTY		DESCRIPTION	CATALOG NUMBER	MFR
	EA	HINGE	AS REQUIRED	IVE
1	EA	ENTRANCE/OFFICE LOCK	ND50	SCH
1	EA	OH STOP	90S	GLY
1	SET	SEALS	188S	ZER
1	EA	COAT AND HAT HOOK	582	IVE

FUNCTION: ND50 (F82) ENTRANCE/OFFICE LOCK
PUSH-BUTTON LOCKING. PUSH-BUTTON LOCKS OUTSIDE LEVER UNTIL UNLOCKED WITH KEY OR BY TURNING INSIDE LEVER.

HW SET: 012S99

QTY		DESCRIPTION	CATALOG NUMBER	MFR
	EA	HINGE	AS REQUIRED	IVE
1	EA	ENTRANCE/OFFICE LOCK	ND50	SCH
1	EA	WALL STOP	WS406	IVE
1	SET	SEALS	188S	ZER
1	EA	COAT AND HAT HOOK	582	IVE

FUNCTION: ND50 (F82) ENTRANCE/OFFICE LOCK
PUSH-BUTTON LOCKING. PUSH-BUTTON LOCKS OUTSIDE LEVER UNTIL UNLOCKED WITH KEY OR BY TURNING INSIDE LEVER.

HW SET: 013S99

QTY		DESCRIPTION	CATALOG NUMBER	MFR
1	EA	CONT. HINGE	112HD	IVE
1	EA	CLASSROOM LOCK	ND70	SCH
1	EA	WALL STOP	WS406	IVE
1	EA	BULB TYPE WTHR STRIP	BY DR/FR SUPPLIER	
1	EA	DOOR BOTTOM	5VA	NGP
1	EA	FINGER GUARD	2248A-76"	NGP

FUNCTION: ND70 (F84) CLASSROOM LOCK
OUTSIDE LEVER LOCKED AND UNLOCKED BY KEY. INSIDE LEVER ALWAYS UNLOCKED.

NOTE: PROVIDE 613 FINISH AT ALL POOL AREA DOORS.

HW SET: 013Z99

QTY		DESCRIPTION	CATALOG NUMBER	MFR
1	EA	CONT. HINGE	112HD	IVE
1	EA	CLASSROOM LOCK	ND70	SCH
1	EA	OH STOP	100S	GLY
1	EA	BULB TYPE WTHR STRIP	BY DR/FR SUPPLIER	
1	EA	DOOR BOTTOM	5VA	NGP
1	EA	FINGER GUARD	2248A-76"	NGP

FUNCTION: ND70 (F84) CLASSROOM LOCK
OUTSIDE LEVER LOCKED AND UNLOCKED BY KEY. INSIDE LEVER ALWAYS UNLOCKED.

HW SET: 014

QTY		DESCRIPTION	CATALOG NUMBER	MFR
	EA	HINGE	AS REQUIRED	IVE
1	EA	STOREROOM LOCK	ND80	SCH
1	EA	WALL STOP	WS406	IVE

FUNCTION: ND80 (F86) STOREROOM LOCK
OUTSIDE LEVER FIXED. ENTRANCE BY KEY ONLY. INSIDE LEVER ALWAYS UNLOCKED.

HW SET: 014Z99

QTY		DESCRIPTION	CATALOG NUMBER	MFR
1	EA	CONT. HINGE	112HD	IVE
1	EA	EXIT X BLANK OUTSIDE	ND25D	SCH
1	EA	KICK PLATE	8400 10" X 1" LDW B-CS	IVE
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	WALL STOP	WS406	IVE
1	EA	FINGER GUARD	2248A-46"	NGP

FUNCTION: ND25 EXIT LOCK
BLANK PLATE OUTSIDE. INSIDE LEVER ALWAYS UNLOCKED.

NOTE: ADD CUSTOM CAP AT TOP OF JAMB ON BOTH HINGE AND LATCH SIDE.

HW SET: 017H

QTY		DESCRIPTION	CATALOG NUMBER	MFR
	EA	HINGE	AS REQUIRED	IVE
1	EA	ELEC CLASSROOM LOCK	CO-100-CY-70-KP	SCE
1	EA	OH STOP & HOLDER	90H	GLY

FUNCTION: WIRELESS KEYPAD LOCK. LATCH RETRACTED BY KEY. OUTSIDE LEVER UNLOCKED BY PIN. INSIDE LEVER ALWAYS UNLOCKED FOR EGRESS. UPON LOSS OF POWER, OUTSIDE LEVER REMAINS LOCKED.

HW SET: 024F

QTY		DESCRIPTION	CATALOG NUMBER	MFR
	EA	HINGE	AS REQUIRED	IVE
2	EA	MANUAL FLUSH BOLT	FB458	IVE
1	EA	DUST PROOF STRIKE	DP2	IVE
1	EA	STOREROOM LOCK	ND80	SCH
2	EA	OH STOP	90S	GLY

FUNCTION: ND80 (F86) STOREROOM LOCK
OUTSIDE LEVER FIXED. ENTRANCE BY KEY ONLY. INSIDE LEVER ALWAYS UNLOCKED.

HW SET: 030A

QTY		DESCRIPTION	CATALOG NUMBER	MFR
	EA	HINGE	AS REQUIRED	IVE
1	EA	CLASSROOM LOCK	ND70	SCH
1	EA	SURFACE CLOSER	4010	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	WALL STOP	WS406	IVE
1	EA	GASKETING	188S	ZER

FUNCTION: ND70 (F84) CLASSROOM LOCK
OUTSIDE LEVER LOCKED AND UNLOCKED BY KEY. INSIDE LEVER ALWAYS UNLOCKED.

HW SET: 030S99

QTY		DESCRIPTION	CATALOG NUMBER	MFR
	EA	HINGE	AS REQUIRED	IVE
1	EA	PASSAGE SET	ND10S	SCH
1	EA	SURFACE CLOSER	4010	LCN
1	EA	WALL STOP	WS406	IVE
1	SET	SEALS	188S	ZER
1	EA	DOOR SWEEP	8192	ZER
1	EA	THRESHOLD	63	ZER

FUNCTION: ND10 (F75) PASSAGE LATCH
BOTH LEVERS ALWAYS UNLOCKED.

HW SET: 031I96

QTY		DESCRIPTION	CATALOG NUMBER	MFR
	EA	HINGE	AS REQUIRED	IVE
1	EA	PRIVACY W/DB & IND	L9496 OCCUPIED/VACANT	SCH
1	EA	WALL STOP	WS406	IVE

FUNCTION: L9496 PRIVACY WITH “OCCUPIED” INDICATOR
LEVER RETRACTS LATCHBOLT FROM EITHER SIDE. DEADBOLT THROWN OR RETRACTED BY KEY OUTSIDE (RETRACTION BY KEY REQUIRED IN THE EVENT OF AN EMERGENCY) OR INSIDE THUMBTURN. THROWING DEADBOLT LOCKS OUTSIDE LEVER AND DISPLAYS “OCCUPIED” PLATE. ROTATING INSIDE LEVER SIMULTANEOUSLY RETRACTS BOTH DEADBOLT AND LATCHBOLT AND UNLOCKS OUTSIDE LEVER.

HW SET: 031I97

QTY		DESCRIPTION	CATALOG NUMBER	MFR
1	EA	CONT. HINGE	112HD	IVE
1	EA	PRIVACY W/DB & IND	L9496 OCCUPIED/VACANT	SCH
1	EA	SURFACE CLOSER	4010 SRI	LCN
1	EA	MOUNTING PLATE	4010-18	LCN
1	EA	WALL STOP	WS406	IVE
1	EA	BULB TYPE WTHR STRIP	BY DR/FR SUPPLIER	
1	EA	DOOR BOTTOM	5VA	NGP
1	EA	FINGER GUARD	2248A-76"	NGP

FUNCTION: L9496 PRIVACY WITH “OCCUPIED” INDICATOR
LEVER RETRACTS LATCHBOLT FROM EITHER SIDE. DEADBOLT THROWN OR RETRACTED BY KEY OUTSIDE (RETRACTION BY KEY REQUIRED IN THE EVENT OF AN EMERGENCY) OR INSIDE THUMBTURN. THROWING DEADBOLT LOCKS OUTSIDE LEVER AND DISPLAYS “OCCUPIED” PLATE. ROTATING INSIDE LEVER SIMULTANEOUSLY RETRACTS BOTH DEADBOLT AND LATCHBOLT AND UNLOCKS OUTSIDE LEVER.

NOTE: PROPER REINFORCEMENT OF ALUMINUM DOOR IS REQUIRED IN ORDER TO PROVIDE ADEQUATE SUPPORT FOR LATCHBOLT AND LOCK CHASSIS.

NOTE: PROVIDE 613 FINISH AT ALL POOL AREA DOORS.

HW SET: 031I98

QTY		DESCRIPTION	CATALOG NUMBER	MFR
	EA	HINGE	AS REQUIRED	IVE
1	EA	PRIVACY W/DB & IND	L9496 OCCUPIED/VACANT	SCH
1	EA	SURFACE CLOSER	4010	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	WALL STOP	WS406	IVE

FUNCTION: L9496 PRIVACY WITH “OCCUPIED” INDICATOR
LEVER RETRACTS LATCHBOLT FROM EITHER SIDE. DEADBOLT THROWN OR RETRACTED BY KEY OUTSIDE (RETRACTION BY KEY REQUIRED IN THE EVENT OF AN EMERGENCY) OR INSIDE THUMBTURN. THROWING DEADBOLT LOCKS OUTSIDE LEVER AND DISPLAYS “OCCUPIED” PLATE. ROTATING INSIDE LEVER SIMULTANEOUSLY RETRACTS BOTH DEADBOLT AND LATCHBOLT AND UNLOCKS OUTSIDE LEVER.

HW SET: 031I99

QTY		DESCRIPTION	CATALOG NUMBER	MFR
1	EA	CONT. HINGE	112HD	IVE
1	EA	PRIVACY W/DB & IND	L9496 OCCUPIED/VACANT	SCH
1	EA	WALL STOP	WS406	IVE
1	EA	BULB TYPE WTHR STRIP	BY DR/FR SUPPLIER	
1	EA	DOOR BOTTOM	5VA	NGP
1	EA	FINGER GUARD	2248A-76"	NGP

FUNCTION: L9496 PRIVACY WITH “OCCUPIED” INDICATOR
LEVER RETRACTS LATCHBOLT FROM EITHER SIDE. DEADBOLT THROWN OR RETRACTED BY KEY OUTSIDE (RETRACTION BY KEY REQUIRED IN THE EVENT OF AN EMERGENCY) OR INSIDE THUMBTURN. THROWING DEADBOLT LOCKS OUTSIDE LEVER AND DISPLAYS “OCCUPIED” PLATE. ROTATING INSIDE LEVER SIMULTANEOUSLY RETRACTS BOTH DEADBOLT AND LATCHBOLT AND UNLOCKS OUTSIDE LEVER.

NOTE: PROPER REINFORCEMENT OF ALUMINUM DOOR IS REQUIRED IN ORDER TO PROVIDE ADEQUATE SUPPORT FOR LATCHBOLT AND LOCK CHASSIS.

HW SET: 034

QTY		DESCRIPTION	CATALOG NUMBER	MFR
	EA	HINGE	AS REQUIRED	IVE
1	EA	STOREROOM LOCK	ND80	SCH
1	EA	SURFACE CLOSER	4010	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	WALL STOP	WS406	IVE
1	EA	GASKETING	188S	ZER

FUNCTION: ND80 (F86) STOREROOM LOCK
OUTSIDE LEVER FIXED. ENTRANCE BY KEY ONLY. INSIDE LEVER ALWAYS UNLOCKED.

HW SET: 034A

QTY		DESCRIPTION	CATALOG NUMBER	MFR
	EA	HINGE	AS REQUIRED	IVE
1	EA	STOREROOM LOCK	ND80	SCH
1	EA	SURFACE CLOSER	4111 EDA	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	WALL STOP	WS406	IVE
1	SET	SEALS	188S	ZER

FUNCTION: ND80 (F86) STOREROOM LOCK
OUTSIDE LEVER FIXED. ENTRANCE BY KEY ONLY. INSIDE LEVER ALWAYS UNLOCKED.

HW SET: 034B

QTY		DESCRIPTION	CATALOG NUMBER	MFR
	EA	HINGE	AS REQUIRED	IVE
1	EA	STOREROOM LOCK	ND80	SCH
1	EA	SURFACE CLOSER	4111 SCUSH	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	SET	SEALS	188S	ZER

FUNCTION: ND80 (F86) STOREROOM LOCK
OUTSIDE LEVER FIXED. ENTRANCE BY KEY ONLY. INSIDE LEVER ALWAYS UNLOCKED.

HW SET: 034X

QTY		DESCRIPTION	CATALOG NUMBER	MFR
	EA	HINGE	AS REQUIRED	IVE
1	EA	STOREROOM W/DEADBOLT	L9480	SCH
1	EA	SURFACE CLOSER	4111 SCUSH	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	RAIN DRIP	142	ZER
1	EA	WEATHERSTIP	429	ZER
1	EA	DOOR SWEEP W/DRIP	8198	ZER
1	EA	THRESHOLD	AS REQUIRED (SEE DETAILS)	

HW SET: 036Z96

QTY		DESCRIPTION	CATALOG NUMBER	MFR
1	EA	CONT. HINGE	112HD	IVE
1	EA	DBL CYL STORE LOCK	ND66	SCH
1	EA	CYLINDER	MTD @ 44" AFF (VERIFY TYPE)	SCH
1	EA	SURFACE CLOSER	4111 SCUSH	LCN
1	EA	KICK PLATE	8400 10"	IVE
1	EA	WALL STOP	WS406	IVE
1	EA	FINGER GUARD	2248A-76"	NGP
1	EA	DOOR BOTTOM	5VA	NGP
1	EA	ALARM	EAX-500	DET

FUNCTION: ND66 (F91) STORE LOCK
KEY IN EITHER LEVER LOCKS OR UNLOCKS BOTH LEVERS.

ALARM ENABLED/DISABLED VIA KEY IN CYLINDER. UNAUTHORIZED EGRESS WILL SOUND ALARM WHEN ENABLED.

HW SET: 036Z97

QTY		DESCRIPTION	CATALOG NUMBER	MFR
1	EA	CONT. HINGE	112HD	IVE
1	EA	DBL CYL STORE LOCK	ND66	SCH
1	EA	SURFACE CLOSER	4010 SRI	LCN
1	EA	MOUNTING PLATE	4010-18	LCN
1	EA	WALL STOP	WS406	IVE
1	EA	BULB TYPE WTHR STRIP	BY DR/FR SUPPLIER	
1	EA	DOOR BOTTOM	5VA	NGP
1	EA	FINGER GUARD	2248A-76"	NGP

FUNCTION: ND66 (F91) STORE LOCK
KEY IN EITHER LEVER LOCKS OR UNLOCKS BOTH LEVERS.

NOTE: PROVIDE 613 FINISH AT ALL POOL AREA DOORS.

HW SET: 036Z98

QTY		DESCRIPTION	CATALOG NUMBER	MFR
1	EA	CONT. HINGE	112HD	IVE
1	EA	DBL CYL STORE LOCK	ND66 MTD @ 54" AFF	SCH
1	EA	SURFACE CLOSER	4010 SRI	LCN
1	EA	MOUNTING PLATE	4010-18	LCN
1	EA	WALL STOP	WS406	IVE
1	EA	BULB TYPE WTHR STRIP	BY DR/FR SUPPLIER	
1	EA	DOOR BOTTOM	5VA	NGP

FUNCTION: ND66 (F91) STORE LOCK
KEY IN EITHER LEVER LOCKS OR UNLOCKS BOTH LEVERS.
NOTE: PROVIDE 613 FINISH AT ALL POOL AREA DOORS.

NOTE: PROVIDE 613 FINISH AT ALL POOL AREA DOORS.

HW SET: 037A

QTY		DESCRIPTION	CATALOG NUMBER	MFR
	EA	HINGE	AS REQUIRED	IVE
1	EA	IC CYLINDER	AS REQUIRED	SCH
1	EA	ELEC CLASSROOM LOCK	CO-100-CY-70-KP	SCE
1	EA	SURFACE CLOSER	4010	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	WALL STOP	WS406	IVE
1	EA	GASKETING	188S	ZER

DOOR NORMALLY CLOSED, LATCH AND SECURE
OUTSIDE LEVER IS RIGID
ENTERING A VALID CODE MOMENTARILY UNLOCKS THE OUTSIDE LEVER.
KEY OUTSIDE RETRACTS LATCHBOLT. KEY CAN ONLY BE REMOVED IN LOCKED POSITION.
LATCHBOLT RETRACTED BY LEVER FROM INSIDE AT ALL TIMES.

HW SET: 037B

QTY		DESCRIPTION	CATALOG NUMBER	MFR
	EA	HINGE	AS REQUIRED	IVE
1	EA	IC CYLINDER	AS REQUIRED	SCH
1	EA	ELEC CLASSROOM LOCK	CO-100-CY-70-KP	SCE
1	EA	SURFACE CLOSER	4111 SCUSH	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE

DOOR NORMALLY CLOSED, LATCH AND SECURE
OUTSIDE LEVER IS RIGID
ENTERING A VALID CODE MOMENTARILY UNLOCKS THE OUTSIDE LEVER.
KEY OUTSIDE RETRACTS LATCHBOLT. KEY CAN ONLY BE REMOVED IN LOCKED POSITION.
LATCHBOLT RETRACTED BY LEVER FROM INSIDE AT ALL TIMES.

HW SET: 037C

QTY		DESCRIPTION	CATALOG NUMBER	MFR
	EA	HINGE	AS REQUIRED	IVE
1	EA	IC CYLINDER	AS REQUIRED	SCH
1	EA	ELEC CLASSROOM LOCK	CO-100-CY-70-KP	SCE
1	EA	SURFACE CLOSER	4111 EDA	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	WALL STOP	WS406	IVE

DOOR NORMALLY CLOSED, LATCH AND SECURE
OUTSIDE LEVER IS RIGID
ENTERING A VALID CODE MOMENTARILY UNLOCKS THE OUTSIDE LEVER.
KEY OUTSIDE RETRACTS LATCHBOLT. KEY CAN ONLY BE REMOVED IN LOCKED POSITION.
LATCHBOLT RETRACTED BY LEVER FROM INSIDE AT ALL TIMES.

HW SET: 037Z90

QTY		DESCRIPTION	CATALOG NUMBER	MFR
1	EA	CONT. HINGE	112HD	IVE
1	EA	IC CYLINDER	AS REQUIRED	SCH
1	EA	ELEC CLASSROOM LOCK	CO-100-CY-70-KP	SCE
1	EA	SURFACE CLOSER	4010 SRI	LCN
1	EA	MOUNTING PLATE	4010-18	LCN
1	EA	WALL STOP	WS406	IVE
1	EA	BULB TYPE WTHR STRIP	BY DR/FR SUPPLIER	
1	EA	DOOR BOTTOM	5VA	NGP

DOOR IS NORMALLY CLOSED, LATCH AND SECURE.
OUTSIDE LEVER IS RIGID.
ENTERING A VALID CODE MOMENTARILY UNLOCKS OUTSIDE LEVER
KEY OUTSIDE RETRACTS LATCHBOLT. KEY CAN ONLY BE REMOVED IN LOCKED POSITION.
LATCHBOLT RETRACTED BY LEVER FROM INSIDE AT ALL TIMES.

NOTE: PROVIDE 613 FINISH AT ALL POOL AREA DOORS.

HW SET: 037Z91

QTY		DESCRIPTION	CATALOG NUMBER	MFR
	EA	HINGE	AS REQUIRED	IVE
1	EA	IC CYLINDER	AS REQUIRED	SCH
1	EA	ELEC CLASSROOM LOCK	CO-100-CY-70-KP	SCE
1	EA	SURFACE CLOSER	4111 DEL SCUSH	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE

DOOR IS NORMALLY CLOSED, LATCHED AND SECURE.
OUTSIDE LEVER IS RIGID.
ENTERING A VALID CODE MOMENTARILY UNLOCKS OUTSIDE LEVER
KEY OUTSIDE RETRACTS LATCHBOLT. KEY CAN ONLY BE REMOVED IN LOCKED POSITION.
LATCHBOLT RETRACTED BY LEVER FROM INSIDE AT ALL TIMES.

HW SET: 037Z95

QTY		DESCRIPTION	CATALOG NUMBER	MFR
1	EA	CONT. HINGE	112HD	IVE
1	EA	IC CYLINDER	AS REQUIRED	SCH
1	EA	ELEC CLASSROOM LOCK	CO-100-CY-70-KP	SCE
1	EA	SURFACE CLOSER	4111 SCUSH	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	FINGER GUARD	2248A-76"	NGP

DOOR IS NORMALLY CLOSED, LATCH AND SECURE.
OUTSIDE LEVER IS RIGID.
ENTERING A VALID CODE MOMENTARILY UNLOCKS OUTSIDE LEVER
KEY OUTSIDE RETRACTS LATCHBOLT. KEY CAN ONLY BE REMOVED IN LOCKED POSITION.
LATCHBOLT RETRACTED BY LEVER FROM INSIDE AT ALL TIMES.

HW SET: 037Z98

QTY		DESCRIPTION	CATALOG NUMBER	MFR
	EA	HINGE	AS REQUIRED	IVE
1	EA	IC CYLINDER	AS REQUIRED	SCH
1	EA	ELEC CLASSROOM LOCK	CO-100-CY-70-KP	SCE
1	EA	SURFACE CLOSER	4111 DEL EDA	LCN
1	EA	KICK PLATE	8400 10"	IVE
1	EA	WALL STOP	WS406	IVE

DOOR IS NORMALLY CLOSED, LATCH AND SECURE.
OUTSIDE LEVER IS RIGID.
ENTERING A VALID CODE MOMENTARILY UNLOCKS OUTSIDE LEVER
KEY OUTSIDE RETRACTS LATCHBOLT. KEY CAN ONLY BE REMOVED IN LOCKED POSITION.
LATCHBOLT RETRACTED BY LEVER FROM INSIDE AT ALL TIMES.

HW SET: 037Z99

QTY		DESCRIPTION	CATALOG NUMBER	MFR
1	EA	CONT. HINGE	112HD	IVE
1	EA	IC CYLINDER	AS REQUIRED	SCH
1	EA	ELEC CLASSROOM LOCK	CO-100-CY-70-KP	SCE
1	EA	SURFACE CLOSER	4010	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	WALL STOP	WS406	IVE
1	EA	FINGER GUARD	2248A-76"	NGP

DOOR IS NORMALLY CLOSED, LATCH AND SECURE.
OUTSIDE LEVER IS RIGID.
ENTERING A VALID CODE MOMENTARILY UNLOCKS OUTSIDE LEVER
KEY OUTSIDE RETRACTS LATCHBOLT. KEY CAN ONLY BE REMOVED IN LOCKED POSITION.
LATCHBOLT RETRACTED BY LEVER FROM INSIDE AT ALL TIMES.

HW SET: 044XH

QTY		DESCRIPTION	CATALOG NUMBER	MFR
2	EA	CONT. HINGE	700	IVE
1	SET	AUTO FLUSH BOLT	AUTOMATIC	IVE
1	EA	DUST PROOF STRIKE	DP2	IVE
1	EA	STOREROOM W/DEADBOLT	L9480	SCH
1	EA	COORDINATOR	COR X FL	IVE
2	EA	SURFACE CLOSER	4111 SHCUSH	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	IVE
1	EA	RAIN DRIP	142	ZER
1	SET	WEATHERSTRIPPING	429	ZER
1	EA	ASTRAGAL	BY DR/FR SUPPLIER	B/O
2	EA	DOOR SWEEP W/DRIP	8198	ZER
1	EA	THRESHOLD	8655	ZER

HW SET: 047ALD

QTY		DESCRIPTION	CATALOG NUMBER	MFR
2	EA	CONT. HINGE	112HD	IVE
1	SET	AUTO FLUSH BOLT	AUTOMATIC LBB	IVE
1	EA	IC CYLINDER	AS REQUIRED	SCH
1	EA	ELEC CLASSROOM LOCK	CO-100-CY-70-KP	SCE
1	EA	COORDINATOR	COR X FL	IVE
2	EA	OH STOP	100S	GLY
2	EA	4010 DEL SRI	4011 DEL SRI	LCN
2	EA	MOUNTING PLATE	4010-18	LCN
1	EA	BULB TYPE WTHR STRIP	BY DR/FR SUPPLIER	

DOOR NORMALLY CLOSED, LATCHED AND SECURE
OUTSIDE LEVER IS RIGID
ENTERING A VALID CODE MOMENTARILY UNLOCKS OUTSIDE LEVER
KEY OUTSIDE RETRACTS LATCHBOLT. KEY CAN ONLY BE REMOVED IN LOCKED POSITION.
LATCHBOLT RETRACTED BY LEVER FROM INSIDE AT ALL TIMES.

NOTE: PROVIDE 613 FINISH AT ALL POOL AREA DOORS.

HW SET: 050A99

QTY		DESCRIPTION	CATALOG NUMBER	MFR
	EA	HINGE	AS REQUIRED	IVE
1	EA	IC CYLINDER	AS REQUIRED	SCH
1	EA	FIRE EXIT HARDWARE	98-L-BE-F	VON
1	EA	EXIT ALARM KIT	ALK-98-RX	VON
1	EA	SURFACE CLOSER	4010	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	WALL STOP	WS406	IVE
1	SET	SEALS	188S	ZER

FUNCTION: (ANSI/BHMA 14) LATCHBOLT RETRACTED BY DEPRESSING THE ACTUATION BAR. ENTRANCE BY LEVER, ALWAYS ACTIVE, NO CYLINDER.

UNAUTHORIZED EXIT WILL SOUND ALARM.

HW SET: 051A98

QTY		DESCRIPTION	CATALOG NUMBER	MFR
	EA	HINGE	AS REQUIRED	IVE
1	EA	PANIC HARDWARE	LD-98-EO	VON
1	EA	SURFACE CLOSER	4111 SCUSH	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
2	EA	GASKETING	188S (1 ROW EA AT STOP & RABBET)	ZER
1	EA	DOOR BOTTOM	369	ZER

FUNCTION: EXIT-ONLY PANIC HARDWARE - NO OUTSIDE TRIM. INSIDE PUSH PAD RETRACTS LATCH FOR EGRESS.

HW SET: 054B

QTY		DESCRIPTION	CATALOG NUMBER	MFR
	EA	HINGE	AS REQUIRED	IVE
1	EA	IC CYLINDER	AS REQUIRED	SCH
1	EA	FIRE EXIT HARDWARE	98-NL-F	VON
1	EA	SURFACE CLOSER	4111 SCUSH	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	GASKETING	188S	ZER

FUNCTION: (ANSI/BHMA 03) LATCHBOLT RETRACTED BY DEPRESSING THE ACTUATION BAR. ENTRANCE BY TRIM WHEN LATCH IS RELEASED BY KEY. KEY ONLY REMOVABLE WHEN LOCKED.

HW SET: 054X

QTY		DESCRIPTION	CATALOG NUMBER	MFR
	EA	HINGE	AS REQUIRED	IVE
1	EA	IC CYLINDER	AS REQUIRED	SCH
1	EA	PANIC HARDWARE	LD-98-NL	VON
1	EA	SURFACE CLOSER	4111 SCUSH	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	RAIN DRIP	142	ZER
1	SET	WEATHERSTRIPPING	429	ZER
1	EA	DOOR SWEEP W/DRIP	8198	ZER
1	EA	THRESHOLD	8655	ZER

FUNCTION: (ANSI/BHMA 03) LATCHBOLT RETRACTED BY DEPRESSING THE ACTUATION BAR. ENTRANCE BY TRIM WHEN LATCH IS RELEASED BY KEY. KEY ONLY REMOVABLE WHEN LOCKED.

HW SET: 161S99

QTY		DESCRIPTION	CATALOG NUMBER	MFR
	EA	HINGE	AS REQUIRED	IVE
1	EA	DOOR PULL, 3/4" RND	8102-8	IVE
1	EA	PUSH PLATE	8200 4" X 16"	IVE
1	EA	SURFACE CLOSER	4010	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	WALL STOP	WS406	IVE
1	SET	SEALS	188S	ZER
1	EA	DOOR SWEEP	8192	ZER

PUSH/PULL

HW SET: 161Z97

QTY		DESCRIPTION	CATALOG NUMBER	MFR
1	EA	SAFETY HINGE	CFM-83LISF-HD	PEM
1	EA	SLIDING DOOR MAG	320M	SCE
1	EA	WALL STOP	WS406	IVE
1	EA	DESK MOUNT BUTTON	660-PB	SCE
1	EA	POWER SUPPLY	PS902 900-4RLFA (SHARED W/ ADJACENT GATE)	SCE
1	EA	FINGER GUARD	2248A-46"	NGP

FUNCTION: MAGNETIC LOCK. GATE NORMALLY CLOSED - MAGNETIC LOCK RELEASED BY DESK-MOUNT BUTTON FOR EGRESS. MAGNETIC LOCK TO RELEASE UPON LOSS OF POWER, SIGNAL FROM FIRE ALARM SYSTEM, OR SIGNAL FROM FIRE COMMAND CENTER.
NOTE: PROVIDE CUSTOM TOP CAP FOR HINGE AND LATCH JAMB.

HW SET: 181

QTY		DESCRIPTION	CATALOG NUMBER	MFR
1	EA	CONT. HINGE	112HD	IVE
1	EA	90 DEG OFFSET PULL	8190-0	IVE
1	EA	PUSH BAR	9100	IVE
1	EA	SURFACE CLOSER	4010	LCN
1	EA	MOUNTING PLATE	4010-18	LCN
1	EA	WALL STOP	WS406	IVE
1	EA	BULB TYPE WTHR STRIP	BY DR/FR SUPPLIER	
1	EA	DOOR BOTTOM	5VA	NGP

PUSH/PULL

HW SET: 181H99

QTY		DESCRIPTION	CATALOG NUMBER	MFR
1	EA	CONT. HINGE	112HD	IVE
1	EA	90 DEG OFFSET PULL	8190-0	IVE
1	EA	PUSH BAR	9100	IVE
1	EA	OH STOP	100S	GLY
1	EA	SURFACE CLOSER	4111 HEDA	LCN
1	EA	MOUNTING PLATE	4110-18	LCN
1	EA	CUSH SHOE SUPPORT	4110-30	LCN
1	EA	BLADE STOP SPACER	4110-61	LCN
1	EA	BULB TYPE WTHR STRIP	BY DR/FR SUPPLIER	
1	EA	DOOR BOTTOM	5VA	NGP

PUSH/PULL

HW SET: 181Z98

QTY		DESCRIPTION	CATALOG NUMBER	MFR
1	EA	CONT. HINGE	112HD	IVE
1	EA	90 DEG OFFSET PULL	8190-0	IVE
1	EA	PUSH BAR	9100	IVE
1	EA	OH STOP	100S	GLY
1	EA	SURFACE CLOSER	4111 EDA	LCN
1	EA	MOUNTING PLATE	4110-18	LCN
1	EA	CUSH SHOE SUPPORT	4110-30	LCN
1	EA	BLADE STOP SPACER	4110-61	LCN
1	EA	BULB TYPE WTHR STRIP	BY DR/FR SUPPLIER	
1	EA	DOOR BOTTOM	5VA	NGP
1	EA	FINGER GUARD	2248A-76"	NGP

PUSH/PULL

HW SET: 182D

QTY		DESCRIPTION	CATALOG NUMBER	MFR
2	EA	CONT. HINGE	112HD	IVE
2	EA	90 DEG OFFSET PULL	8190-0	IVE
2	EA	PUSH BAR	9100	IVE
2	EA	OH STOP	100S	GLY
2	EA	SURFACE CLOSER	4111 EDA	LCN
2	EA	MOUNTING PLATE	4110-18	LCN
2	EA	CUSH SHOE SUPPORT	4110-30	LCN
2	EA	BLADE STOP SPACER	4110-61	LCN
2	EA	DOOR BOTTOM	5VA	NGP

PUSH/PULL

HW SET: 182H99

QTY		DESCRIPTION	CATALOG NUMBER	MFR
2	EA	CONT. HINGE	112HD	IVE
2	EA	90 DEG OFFSET PULL	8190-0	IVE
2	EA	PUSH BAR	9100	IVE
2	EA	OH STOP	100S	GLY
2	EA	SURFACE CLOSER	4111 HEDA	LCN
2	EA	MOUNTING PLATE	4110-18	LCN
2	EA	CUSH SHOE SUPPORT	4110-30	LCN
2	EA	BLADE STOP SPACER	4110-61	LCN

PUSH/PULL

HW SET: 183X

QTY		DESCRIPTION	CATALOG NUMBER	MFR
1	EA	CONT. HINGE	112HD	IVE
1	EA	CLASSROOM DEAD LOCK	L463	SCH
1	EA	90 DEG OFFSET PULL	8190-0	IVE
1	EA	PUSH BAR	9100	IVE
1	EA	SURFACE CLOSER	4010	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	WALL STOP	WS406	IVE
1	EA	RAIN DRIP	142	ZER
1	EA	WEATHERSTRIP	BY DR/FR SUPPLIER	
1	EA	DOOR BOTTOM	15NA	NGP
1	EA	THRESHOLD	8655	ZER

FUNCTION: (E06091) CLASSROOM DEAD LOCK. OUTSIDE KEY EXTENDS OR RETRACTS DEADBOLT. INSIDE TURN CAN ONLY RETRACT DEADBOLT.

HW SET: 233Z96

QTY		DESCRIPTION	CATALOG NUMBER	MFR
1	EA	CONT. HINGE	112HD	IVE
1	EA	CLASSROOM LOCK	ND70	SCH
1	EA	CYLINDER	(VERIFY TYPE)	SCH
1	EA	SURFACE CLOSER	4010	LCN
1	EA	MOUNTING PLATE	4010-18	LCN
1	EA	WALL STOP	WS406	IVE
1	EA	BULB TYPE WTHR STRIP	BY DR/FR SUPPLIER	
2	EA	DOOR BOTTOM	5VA	NGP
1	EA	ALARM	EAX-500	DET
1	EA	FINGER GUARD	2248A-76"	NGP

FUNCTION: ND70 (F84) CLASSROOM LOCK
OUTSIDE LEVER LOCKED AND UNLOCKED BY KEY. INSIDE LEVER ALWAYS UNLOCKED.

ALARM ENABLED/DISABLED VIA KEY IN CYLINDER. UNAUTHORIZED EGRESS WILL SOUND ALARM WHEN ENABLED.

HW SET: 233Z99

QTY		DESCRIPTION	CATALOG NUMBER	MFR
1	EA	CONT. HINGE	112HD	IVE
1	EA	CLASSROOM LOCK	ND70	SCH
1	EA	CYLINDER	(VERIFY TYPE)	SCH
1	EA	SURFACE CLOSER	4111 EDA	LCN
1	EA	MOUNTING PLATE	4110-18	LCN
1	EA	CUSH SHOE SUPPORT	4110-30	LCN
1	EA	BLADE STOP SPACER	4110-61	LCN
1	EA	WALL STOP	WS406	IVE
1	EA	BULB TYPE WTHR STRIP	BY DR/FR SUPPLIER	
2	EA	DOOR BOTTOM	5VA	NGP
1	EA	ALARM	EAX-500	DET
1	EA	FINGER GUARD	2248A-76"	NGP

FUNCTION: ND70 (F84) CLASSROOM LOCK
OUTSIDE LEVER LOCKED AND UNLOCKED BY KEY. INSIDE LEVER ALWAYS UNLOCKED.

ALARM ENABLED/DISABLED VIA KEY IN CYLINDER. UNAUTHORIZED EGRESS WILL SOUND ALARM WHEN ENABLED.

HW SET: 236Z97

QTY		DESCRIPTION	CATALOG NUMBER	MFR
1	EA	CONT. HINGE	112HD	IVE
1	EA	DBL CYL STORE LOCK	ND66	SCH
1	EA	CYLINDER	(VERIFY TYPE)	SCH
1	EA	SURFACE CLOSER	4010	LCN
1	EA	MOUNTING PLATE	4010-18	LCN
1	EA	WALL STOP	WS406	IVE
1	EA	BULB TYPE WTHR STRIP	BY DR/FR SUPPLIER	
1	EA	DOOR BOTTOM	5VA	NGP
1	EA	ALARM	EAX-500	DET
1	EA	FINGER GUARD	2248A-76"	NGP

FUNCTION: ND66 (F91) STORE LOCK
KEY IN EITHER LEVER LOCKS OR UNLOCKS BOTH LEVERS.

ALARM ENABLED/DISABLED VIA KEY IN CYLINDER. UNAUTHORIZED EGRESS WILL SOUND ALARM WHEN ENABLED.

HW SET: 237A02

QTY		DESCRIPTION	CATALOG NUMBER	MFR
1	EA	CONT. HINGE	112HD	IVE
1	EA	IC CYLINDER	AS REQUIRED	SCH
1	EA	ELEC CLASSROOM LOCK	CO-100-CY-70-KP	SCE
1	EA	4010 DEL SRI	4011 DEL SRI	LCN
1	EA	MOUNTING PLATE	4010-18	LCN
1	EA	WALL STOP	WS406	IVE
1	EA	BULB TYPE WTHR STRIP	BY DR/FR SUPPLIER	
1	EA	DOOR BOTTOM	5VA	NGP

DOOR IS NORMALLY CLOSED, LATCH AND SECURE.
OUTSIDE LEVER IS RIGID.
ENTERING A VALID CODE MOMENTARILY UNLOCKS OUTSIDE LEVER
KEY OUTSIDE RETRACTS LATCHBOLT. KEY CAN ONLY BE REMOVED IN LOCKED POSITION.
LATCHBOLT RETRACTED BY LEVER FROM INSIDE AT ALL TIMES.

NOTE: PROVIDE 613 FINISH AT ALL POOL AREA DOORS.

HW SET: 251X95

QTY		DESCRIPTION	CATALOG NUMBER	MFR
1	EA	CONT. HINGE	700	IVE
2	EA	IC CYLINDER	AS REQUIRED	SCH
1	EA	EXIT ALARM KIT	ALK-98-RX	VON
1	EA	PANIC HARDWARE	LD-XP-98-EO (MOUNT AT 54" AFF)	VON
1	EA	SURFACE CLOSER	4111 SCUSH	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	RAIN DRIP	142	ZER
1	SET	WEATHERSTRIPPING	429	ZER
1	EA	DOOR SWEEP W/DRIP	8198	ZER
1	EA	THRESHOLD	8655	ZER

FUNCTION: EXIT-ONLY PANIC HARDWARE - NO OUTSIDE TRIM. INSIDE PUSH PAD RETRACTS LATCH FOR EGRESS.
WHEN ARMED, PUSHING INSIDE PUSH PAD SOUNDS INTERNAL ALARM HORN UNTIL DISARMED OR RESET. INSIDE KEY CYLINDER ARMS/DISARMS/RESETS ALARM.

HW SET: 253X98

QTY		DESCRIPTION	CATALOG NUMBER	MFR
1	EA	CONT. HINGE	112HD	IVE
2	EA	IC CYLINDER	AS REQUIRED	SCH
1	EA	PANIC HARDWARE	LD-98-L	VON
1	EA	EXIT ALARM KIT	ALK-98-RX	VON
1	EA	OH STOP	100S	GLY
1	EA	SURFACE CLOSER	4111 EDA	LCN
1	EA	MOUNTING PLATE	4110-18	LCN
1	EA	CUSH SHOE SUPPORT	4110-30	LCN
1	EA	BLADE STOP SPACER	4110-61	LCN
1	EA	RAIN DRIP	142 (OMIT AT SHELTERED DOORS)	ZER
1	EA	WEATHERSTRIP	BY DR/FR SUPPLIER	
1	EA	DOOR BOTTOM	15NA	NGP
1	EA	THRESHOLD	AS REQUIRED (SEE DETAILS)	

FUNCTION: (L) LATCHBOLT RETRACTED INSIDE BY EXIT DEVICE PUSH PAD AND OUTSIDE BY KEY IN CYLINDER. KEY IN CYLINDER LOCKS AND UNLOCKS OUTSIDE LEVER.

TURNING KEY CLOCKWISE ON DEVICE END RAIL ACTIVATES ALARM. LOW AUDIBLE ALARM CHIRP INDICATES ALARM HAS BEEN ACTIVATED.
DEPRESSING TOUCH PAD INSIDE ALLOWS FREE EGRESS AT ALL TIMES AND SOUNDS ALARM. ALARM WILL CONTINUE TO SOUND UNTIL RESET BY CYLINDER OR WILL AUTOMATICALLY RESET AFTER FIVE MINUTES IN ALARM STATUS.
RED TOUCH PAD INDICATES - "EMERGENCY EXIT ONLY, ALARM WILL SOUND".

HW SET: 254X97

QTY		DESCRIPTION	CATALOG NUMBER	MFR
1	EA	CONT. HINGE	112HD	IVE
1	EA	IC CYLINDER	AS REQUIRED	SCH
1	EA	PANIC HARDWARE	CD-98-NL-OP (VERIFY MOUNTING HEIGHT)	VON
1	EA	90 DEG OFFSET PULL	8190-0	IVE
1	EA	OH STOP	100S	GLY
1	EA	SURFACE CLOSER	4111 EDA	LCN
1	EA	MOUNTING PLATE	4110-18	LCN
1	EA	CUSH SHOE SUPPORT	4110-30	LCN
1	EA	BLADE STOP SPACER	4110-61	LCN
1	EA	RAIN DRIP	142	ZER
1	EA	WEATHERSTRIP	BY DR/FR SUPPLIER	
1	EA	DOOR BOTTOM	15NA	NGP
1	EA	THRESHOLD	AS REQUIRED (SEE DETAILS)	

FUNCTION: NIGHT LATCH PANIC HARDWARE. FIXED OUTSIDE TRIM - LATCH RETRACTED BY KEY. INSIDE PUSH PAD RETRACTS LATCH FOR EGRESS. LATCH DOGGED BY INSIDE CYLINDER FOR PUSH/PULL OPERATION.

HW SET: 254X98

QTY		DESCRIPTION	CATALOG NUMBER	MFR
1	EA	CONT. HINGE	112HD	IVE
2	EA	IC CYLINDER	AS REQUIRED	SCH
1	EA	EXIT ALARM KIT	ALK-98-RX	VON
1	EA	PANIC HARDWARE	LD-XP-98-NL-OP	VON
1	EA	90 DEG OFFSET PULL	8190-0	IVE
1	EA	OH STOP	100S	GLY
1	EA	SURFACE CLOSER	4111 EDA	LCN
1	EA	MOUNTING PLATE	4110-18	LCN
1	EA	CUSH SHOE SUPPORT	4110-30	LCN
1	EA	BLADE STOP SPACER	4110-61	LCN
1	EA	RAIN DRIP	142	ZER
1	EA	WEATHERSTRIP	BY DR/FR SUPPLIER	
1	EA	DOOR BOTTOM	15NA	NGP
1	EA	THRESHOLD	AS REQUIRED (SEE DETAILS)	

FUNCTION: NIGHT LATCH PANIC HARDWARE. FIXED OUTSIDE TRIM - LATCH RETRACTED BY KEY. INSIDE PUSH PAD RETRACTS LATCH FOR EGRESS. LATCH DOGGED BY INSIDE CYLINDER FOR PUSH/PULL OPERATION.

UNAUTHORIZED EXIT WILL SOUND ALARM.

HW SET: 254X99

QTY		DESCRIPTION	CATALOG NUMBER	MFR
1	EA	CONT. HINGE	112HD	IVE
3	EA	IC CYLINDER	AS REQUIRED	SCH
1	EA	PANIC HARDWARE	CD-98-NL-OP	VON
1	EA	EXIT ALARM KIT	ALK-98-RX	VON
1	EA	SPECIAL 1-PIECE	COVER W/2 HOLES: 1 EA FOR CD AND ALK	VON
1	EA	DOOR PULL	RM6171 24"	ROC
1	EA	OH STOP	100S	GLY
1	EA	SURFACE CLOSER	4111 EDA	LCN
1	EA	MOUNTING PLATE	4110-18	LCN
1	EA	CUSH SHOE SUPPORT	4110-30	LCN
1	EA	BLADE STOP SPACER	4110-61	LCN
1	EA	RAIN DRIP	142	ZER
1	EA	WEATHERSTRIP	BY DR/FR SUPPLIER	
1	EA	DOOR BOTTOM	15NA	NGP
1	EA	THRESHOLD	AS REQUIRED (SEE DETAILS)	
1	EA	FINGER GUARD	2248A-76"	NGP

FUNCTION:
DOORS NORMALLY CLOSED, LATCHED AND SECURED
OUTSIDE TRIM FOR ACCESS
TURNING KEY CLOCKWISE ON DEVICE END RAIL ACTIVATES ALARM. LOW AUDIBLE ALARM CHIRP INDICATES ALARM HAS BEEN ACTIVATED.
DEPRESSING TOUCH PAD INSIDE ALLOWS FREE EGRESS AT ALL TIMES AND SOUNDS ALARM. ALARM WILL CONTINUE TO SOUND UNTIL RESET BY CYLINDER OR WILL AUTOMATICALLY RESET AFTER FIVE MINUTES IN ALARM STATUS.
WHILE HOLDING TOUCHPAD DEPRESSED, TURN KEY CLOCKWISE HOLDS TOUCHPAD DEPRESSED AND UNIT IS DISARMED. DOOR IS PUSH/PULL.
RED TOUCH PAD INDICATES - "EMERGENCY EXIT ONLY, ALARM WILL SOUND".

NOTE: CYLINDER DOGGING (CD) FUNCTION CAN ONLY BE USED WITH AN ALARM KIT ON 4 FOOT DEVICES. IF CD FUNCTION CANNOT BE USED, SUBSTITUTE SPECIAL DOGGING (SD) FUNCTION.

HW SET: 263X99

QTY		DESCRIPTION	CATALOG NUMBER	MFR
2	EA	CONT. HINGE	112HD	IVE
1	EA	REMOVABLE MULLION	KR4954	VON
3	EA	IC CYLINDER	AS REQUIRED	SCH
2	EA	PANIC HARDWARE	LD-98-L (MOUNT AT 54" AFF)	VON
2	EA	OH STOP	100S	GLY
2	EA	SURFACE CLOSER	4111 EDA SRI	LCN
2	EA	MOUNTING PLATE	4110-18	LCN
2	EA	CUSH SHOE SUPPORT	4110-30	LCN
2	EA	BLADE STOP SPACER	4110-61	LCN
1	EA	RAIN DRIP	142	ZER
1	EA	WEATHERSTRIP	BY DR/FR SUPPLIER	
1	EA	MULLION SEAL	8780	ZER
2	EA	DOOR BOTTOM	15NA	NGP
1	EA	THRESHOLD	8655	ZER

FUNCTION: (L) LATCHBOLT RETRACTED INSIDE BY EXIT DEVICE PUSH PAD AND OUTSIDE BY KEY IN CYLINDER. KEY IN CYLINDER LOCKS AND UNLOCKS OUTSIDE LEVER.

NOTE: PROVIDE 613 FINISH AT ALL POOL AREA DOORS.

HW SET: 264D

QTY		DESCRIPTION	CATALOG NUMBER	MFR
2	EA	CONT. HINGE	112HD	IVE
3	EA	IC CYLINDER	AS REQUIRED	SCH
1	EA	PANIC HARDWARE	CD-9847-EO	VON
1	EA	PANIC HARDWARE	CD-9847-NL-OP	VON
2	EA	90 DEG OFFSET PULL	8190-0	IVE
2	EA	OH STOP	100S	GLY
2	EA	SURFACE CLOSER	4111 EDA	LCN
2	EA	MOUNTING PLATE	4110-18	LCN
2	EA	CUSH SHOE SUPPORT	4110-30	LCN
2	EA	BLADE STOP SPACER	4110-61	LCN
1	EA	WEATHERSTRIP	BY DR/FR SUPPLIER	
2	EA	DOOR BOTTOM	5VA	NGP
1	EA	FINGER GUARD	2248A-76"	NGP

FUNCTION: (ANSI/BHMA 03) LATCHBOLT RETRACTED BY DEPRESSING THE ACTUATION BAR. ENTRANCE BY TRIM WHEN LATCH IS RELEASED BY KEY. KEY ONLY REMOVABLE WHEN LOCKED

DAY MODE: DEPRESSING TOUCH PAD ADN ROTATING CYLINDER ON DEVIE END RAIL WILL HOLD TOUCH PAD RETRACTED. DOOR IS PUSH/PULL OPERATION

NIGHT MODE: DEPRESSING TOUCH PAD AND ROTATING CYLIDNER ON DEVICE END RAIL WILL RELEASE TOUCH PAD AND EXTEND LATCHBOLT, SECURING THE DOOR.

HW SET: 264E59

QTY		DESCRIPTION	CATALOG NUMBER	MFR
2	EA	CONT. HINGE	112HD EPT	IVE
2	EA	POWER TRANSFER	EPT2	VON
1	EA	REMOVABLE MULLION	KR4954	VON
3	EA	IC CYLINDER	AS REQUIRED	SCH
1	EA	ELEC PANIC HARDWARE	QEL-98-EO	VON
1	EA	ELEC PANIC HARDWARE	QEL-98-NL-OP	VON
2	EA	90 DEG OFFSET PULL	8190-0	IVE
2	EA	OH STOP	100S	GLY
1	EA	SURFACE CLOSER	4111 EDA	LCN
1	EA	SURF. AUTO OPERATOR	4642	LCN
1	EA	MOUNTING PLATE	4110-18	LCN
1	EA	CUSH SHOE SUPPORT	4110-30	LCN
1	EA	BLADE STOP SPACER	4110-61	LCN
1	EA	ACTUATOR, JAMB MOUNT	8310-818T	LCN
1	EA	MULLION SEAL	8780	ZER
2	EA	DOOR BOTTOM	5VA	NGP
1	EA	KEY SWITCH	653-14 NS	SCE
1	EA	POWER SUPPLY	PS902 900-2RS	SCE
1	EA	WIRING DIAGRAMS	RISER & POINT-TO-POINT (BY HARDWARE SUPPLIER)	

FUNCTION: NIGHT LATCH PANIC HARDWARE WITH ELECTRIC LATCH RETRACTION. FIXED OUTSIDE TRIM - LATCH RETRACTED BY KEY. INSIDE PUSH PAD RETRACTS LATCH FOR EGRESS.
DAYTIME OPERATION: ROTATING KEY SWITCH ELECTRICALLY RETRACTS LATCH AND ACTIVATES OUTSIDE PUSH PLATE ACTUATOR FOR PUSH/PULL OR AUTOMATIC OPERATION. NO INSIDE PUSH PLATE ACTUATOR.
NIGHTIME OPERATION: ROTATING KEY SWITCH ELECTRICALLY EXTENDS LATCH AND DISABLES OUTSIDE PUSH PLATE ACTUATOR. REMOTE PUSH BUTTON MOMENTARILY RETRACTS LATCH AND PROVIDES POWER TO OUTSIDE PUSH PLATE ACTUATOR FOR PUSH/PULL OR AUTOMATIC OPERATION.
NOTE: ELECTRICAL BOXES, CONDUIT, AND FINAL CONNECTIONS TO ELECTRIC POWER TRANSFER, EXIT DEVICES, AUTOMATIC OPERATORS, ACTUATORS, AND POWER SUPPLY SHALL BE THE RESPONSIBILITY OF DIVISION 16.

HW SET: 264E60

QTY		DESCRIPTION	CATALOG NUMBER	MFR
1	EA	CONT. HINGE	112HD	IVE
1	EA	CONT. HINGE	112HD EPT	IVE
1	EA	POWER TRANSFER	EPT2	VON
1	EA	REMOVABLE MULLION	KR4954	VON
1	EA	IC CYLINDER	AS REQUIRED	SCH
1	EA	PANIC HARDWARE	LD-98-EO	VON
1	EA	ELEC PANIC HARDWARE	QEL-98-EO	VON
2	EA	OH STOP	100S	GLY
1	EA	SURFACE CLOSER	4111 EDA	LCN
1	EA	SURF. AUTO OPERATOR	4642	LCN
1	EA	MOUNTING PLATE	4110-18	LCN
1	EA	CUSH SHOE SUPPORT	4110-30	LCN
1	EA	BLADE STOP SPACER	4110-61	LCN
1	EA	ACTUATOR, JAMB MOUNT	8310-818T	LCN
1	EA	MULLION SEAL	8780	ZER
2	EA	DOOR BOTTOM	5VA	NGP
1	EA	KEY SWITCH	653-14 NS	SCE
1	EA	POWER SUPPLY	PS902 900-2RS	SCE
1	EA	WIRING DIAGRAMS	RISER & POINT-TO-POINT (BY HARDWARE SUPPLIER)	

FUNCTION: EXIT-ONLY PANIC HARDWARE WITH ELECTRIC LATCH RETRACTION. NO OUTSIDE TRIM. INSIDE PUSH PAD RETRACTS LATCH FOR EGRESS.
DOOR NORMALLY LATCHED. INSIDE PUSH PLATE ACTUATOR ELECTRICALLY RETRACTS LATCH AND AUTOMATICALLY OPENS DOOR.
NOTE: ELECTRICAL BOXES, CONDUIT, AND FINAL CONNECTIONS TO ELECTRIC POWER TRANSFER, EXIT DEVICES, AUTOMATIC OPERATORS, ACTUATORS, AND POWER SUPPLY SHALL BE THE RESPONSIBILITY OF DIVISION 16.

HW SET: 264X80

QTY		DESCRIPTION	CATALOG NUMBER	MFR
1	EA	CONT. HINGE	112HD	IVE
1	EA	CONT. HINGE	112HD EPT	IVE
1	EA	POWER TRANSFER	EPT2	VON
1	EA	KEYED REMOVABLE MULLION	KR4954	VON
2	EA	IC CYLINDER	AS REQUIRED	SCH
1	EA	PANIC HARDWARE	CD-98-EO	VON
1	EA	ELEC PANIC HARDWARE	LX-CD-98-NL-OP	VON
2	EA	90 DEG OFFSET PULL	8190-0	IVE
2	EA	OH STOP	100S	GLY
1	EA	SURFACE CLOSER	4111 EDA	LCN
1	EA	SURF. AUTO OPERATOR	4642	LCN
1	EA	MOUNTING PLATE	4110-18	LCN
1	EA	CUSH SHOE SUPPORT	4110-30	LCN
1	EA	BLADE STOP SPACER	4110-61	LCN
1	EA	ACTUATOR, JAMB MOUNT	8310-818T	LCN
1	EA	ACTUATOR, WALL MOUNT	8310-856T	LCN
1	EA	WEATHERSTRIP	BY DR/FR SUPPLIER	
1	EA	MULLION SEAL	8780	ZER
2	EA	DOOR BOTTOM	15NA	NGP
1	EA	THRESHOLD	PROFILE AS REQUIRED	ZER
1	EA	ELEVATION DRAWING		
1	EA	WIRE DIAGRAM	POINT TO POINT	

FUNCTION: NIGHT LATCH PANIC HARDWARE. FIXED OUTSIDE TRIM - LATCH RETRACTED BY KEY. INSIDE PUSH PAD RETRACTS LATCH FOR EGRESS.
DAYTIME OPERATION: LATCH DOGGED BY INSIDE CYLINDER FOR PUSH/PULL OPERATION. LX SWITCH ACTIVATES ACTUATORS FOR AUTOMATIC OPERATION.
NIGHTTIME OPERATION: LATCH DOGGING RELEASED BY INSIDE CYLINDER FOR NIGHTLATCH OPERATION. LX SWITCH DEACTIVATES ACTUATORS WHILE DOOR IS LOCKED.
NOTE: ELECTRICAL BOXES, CONDUIT, AND FINAL CONNECTIONS TO ELECTRIC POWER TRANSFER, EXIT DEVICES, AUTOMATIC OPERATORS, ACTUATORS, AND POWER SUPPLY SHALL BE THE RESPONSIBILITY OF DIVISION 16.

HW SET: 264X98

QTY		DESCRIPTION	CATALOG NUMBER	MFR
2	EA	CONT. HINGE	112HD	IVE
1	EA	REMOVABLE MULLION	KR4954	VON
3	EA	IC CYLINDER	AS REQUIRED	SCH
2	EA	EXIT ALARM KIT	ALK-98-RX	VON
1	EA	PANIC HARDWARE	LD-XP-98-EO	VON
1	EA	PANIC HARDWARE	LD-XP-98-NL-OP	VON
2	EA	90 DEG OFFSET PULL	8190-0	IVE
2	EA	OH STOP	100S	GLY
2	EA	SURFACE CLOSER	4111 EDA SRI	LCN
2	EA	MOUNTING PLATE	4110-18	LCN
2	EA	CUSH SHOE SUPPORT	4110-30	LCN
2	EA	BLADE STOP SPACER	4110-61	LCN
1	EA	RAIN DRIP	142	ZER
1	EA	WEATHERSTRIP	BY DR/FR SUPPLIER	
1	EA	MULLION SEAL	8780	ZER
2	EA	DOOR BOTTOM	15NA	NGP
1	EA	THRESHOLD	8655	ZER

FUNCTION: NIGHT LATCH PANIC HARDWARE. FIXED OUTSIDE TRIM - LATCH RETRACTED BY KEY. INSIDE PUSH PAD RETRACTS LATCH FOR EGRESS.

UNAUTHORIZED EXIT WILL SOUND ALARM.

NOTE: PROVIDE 613 FINISH AT ALL POOL AREA DOORS.

HW SET: 634E02

QTY		DESCRIPTION	CATALOG NUMBER	MFR
1	EA	CONT. HINGE	112HD	IVE
1	EA	STOREROOM LOCK	ND80	SCH
1	EA	ELECTRIC STRIKE	6211 FSE	VON
1	EA	SURFACE CLOSER	4010	LCN
1	EA	MOUNTING PLATE	4010-18	LCN
1	EA	WALL STOP	WS406	IVE
1	EA	BULB-TYPE WEATHERSTRIP	BY DOOR SUPPLIER	
1	EA	DOOR BOTTOM	5VA	NGP
1	EA	CARD READER	BY SECURITY SUPPLIER	
1	EA	DOOR POSITION SWITCH	BY SECURITY SUPPLIER	
1	EA	POWER SUPPLY	PS902 900-4R	SCE
1	EA	AXIS CONTROLLER	BY SECURITY SUPPLIER	AXS
1	EA	ELEVATION DRAWING		
1	EA	WIRE DIAGRAM	POINT TO POINT	
1	EA	REQUEST TO EXIT	BY SECURITY SUPPLIER	

FUNCTION: ND80 (F86) STOREROOM LOCK
OUTSIDE LEVER FIXED. ENTRANCE BY KEY ONLY. INSIDE LEVER ALWAYS UNLOCKED.

PRESENTATION OF A VALID CREDENTIAL WILL MOMENTARILY UNLOCK THE DOOR.

HW SET: 634E03

QTY		DESCRIPTION	CATALOG NUMBER	MFR
	EA	HINGE	AS REQUIRED	IVE
1	EA	STOREROOM LOCK	ND80	SCH
1	EA	ELECTRIC STRIKE	6211 FSE	VON
1	EA	SURFACE CLOSER	4111 EDA	LCN
1	EA	WALL STOP	WS406	IVE
1	EA	CARD READER	BY SECURITY SUPPLIER	
1	EA	DOOR POSITION SWITCH	BY SECURITY SUPPLIER	
1	EA	POWER SUPPLY	PS902 900-4R	SCE
1	EA	AXIS CONTROLLER	BY SECURITY SUPPLIER	AXS
1	EA	ELEVATION DRAWING		
1	EA	WIRE DIAGRAM	POINT TO POINT	
1	EA	REQUEST TO EXIT	BY SECURITY SUPPLIER	

FUNCTION: ND80 (F86) STOREROOM LOCK
OUTSIDE LEVER FIXED. ENTRANCE BY KEY ONLY. INSIDE LEVER ALWAYS UNLOCKED.

PRESENTATION OF A VALID CREDENTIAL WILL MOMENTARILY UNLOCK THE DOOR.

HW SET: 996

QTY		DESCRIPTION	CATALOG NUMBER	MFR
1	EA	GATE SPRINGS	450	MCK
1	EA	IC CYLINDER	AS REQUIRED	SCH
1	EA	RIM ALARMED EXIT	V40EB X W (EXIT ONLY)	DET

GATE NORMALLY CLOSED, LATCHED AND SECURED
NO OUTSIDE TRIM FOR ACCESS.
TURNING KEY CLOCKWISE ON DEVICE END RAIL ACTIVATES ALARM. LOW AUDIBLE CHIRP INDICATES ALARM HAS BEEN ACTIVATED.
DEPRESSING TOUCHPAD INSIDE ALLOW FREE EGRESS AT ALL TIMES AND SOUND ALARM. ALARM WILL CONTINUE TO SOUND UNTIL RESET BY CYLINDER OR WILL AUTOMATICLLY RESET AFTER FIVE MINUTES IN A LARM STATUS.
RED TOUCHPAD INDICATES - "EMERGENCY EXIT ONLY, ALARM WILL SOUND"

END OF SECTION

SECTION 08 81 00
GLAZING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Insulated glass and glazing for aluminum windows, entrances, storefronts, and curtainwall.

B. Monolithic Glazing for interior wood doors, hollow metal doors and side-lites, decorative metal handrails and smoke baffles.

C. Unframed mirrors and metal trim.

D. Glazed food service fixtures and metal trim.

E. Decorative Cast Glass.

1.02 RELATED SECTIONS

A. Section 01 33 00 - Submittal Procedures.

B. Section 01 40 00 - Quality Requirements.

C. Section 01 60 00 - Product Requirements.

D. Section 05 70 00 - Decorative Metal.

E. Section 05 73 13 - Glazed Decorative Metal Railings.

F. Section 08 08 00 - Commissioning of Openings.

G. Section 08 11 13 - Hollow Metal Doors and Frames.

H. Section 08 14 16 - Flush Wood Doors.

I. Section 08 38 00 - Traffic Doors.

J. Section 08 41 13 - Aluminum Framed Entrances and Storefronts

K. Section 08 42 45 - Sliding Aluminum Doors.

L. Section 08 44 13 - Glazed Aluminum Curtain Walls.

M. Section 08 87 13 - Solar Control Film.

1.03 REFERENCE STANDARDS

A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; Current Edition.

B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015 (Reaffirmed 2020).

C. ASTM C1036 - Standard Specification for Flat Glass; 2021.

D. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.

E. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass; 2019.

F. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror; 2024.

G. ASTM E576 - Standard Test Method for Frost/Dew Point of Sealed Insulating Glass Units in the Vertical Position; Current Edition.

H. ASTM E2188 - Standard Test Method for Insulating Glass Unit Performance; 2019.

I. ASTM E2189 - Standard Test Method for Testing Resistance to Fogging in Insulating Glass Units; 2019.

J. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2019.

K. ASTM E2358 - Standard Specification for the Performance of Glass in Permanent Glass Railing Systems, Guards, and Balustrades; 2017.

L. CPSC 16CFR1201 - SAFETY STANDARD FOR ARCHITECTURAL GLAZING MATERIALS; 2016.

M. GSA CID A-A-3002 - Mirrors, Glass; 1996.

N. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2025.

O. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2022.

P. NFPA 257 - Standard on Fire Test for Window and Glass Block Assemblies; 2022.

Q. FGMA Glazing Manual - Flat Glass Marketing Association.

1.04 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Comply with safety glazing requirements of ANSI Z97.1 and CPSC 16CFR1201.

C. Conform to Flat Glass Marketing Association (FGMA) Glazing Manual for glazing installation methods.

D. Provide insulating glass units permanently marked with certification label of Insulating Glass Certification Council (IGCC) indicating compliance with Class CBA.

E. Fire Rated Door Assemblies: Provide assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.

F. Fire Rated Window Assemblies: Provide assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 257.

1.05 SUBMITTALS

A. Material and Equipment Submittals: Submit the following under provisions of Section 01 33 00-Submittals:
   1. Product Data:
      a. Glass Units: Provide product data indicating compliance with specified requirements. Include information on size limitations, special handling or installation requirements.
      b. Glazing Sealant: Provide data on glazing sealant. Identify colors available.
      c. Calculations prepared by a professional engineer, licensed in the state in which the project is located, for the design of all glass units and showing that the glass units meet the building code.
   2. Samples for Verification:
      a. Glass Units: Submit three 12" x 12" samples of each type of tinted insulating glass specified. Submit Insulating Glass samples with Project specific features such as spacer bar and hermetic seal construction, low-E coatings and other specified features. Samples shall show extremes of variation / range of appearance if applicable.
      b. Laminated Glass: Submit three 12” x 12” samples of each type of laminated glass for final approval of interlayer color.
      c. Glazing Sealant: Submit color samples for color selection.

B. Quality Assurance Submittals: Submit the following under provisions of Section 01 40 00:
   1. Manufacturer's Certificate: Submit sealed glass unit manufacturer's certificate indicating units meet or exceed specified to requirements.

C. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.
   3. See Sections 01 33 00: Submittal Procedures and 01 60 00: Product Requirements.

D. Closeout Submittals: Submit the following under provisions of Section 01 77 00: Closeout Procedures.
   1. Warranty: As specified in this Section.

1.06 WARRANTY

A. Insulating Glass: Provide written ten-year manufacturer's warranty, including coverage of sealed glass units from seal failure due manufacturing defects, as evidenced by inner-pane dusting or misting, and replacement of same.

B. Provide written ten-year warranty covering reflective coating against peeling, and other indications of deterioration in reflective coating.

1.07 DEFINITIONS

A. GANA – Glass Association of North America.

PART 2 PRODUCTS

2.01 GLASS PRODUCTS

A. Coordinate U-factors with frames to provide a total assembly values.

B. Solar Control Low-E Clear Insulated Glass Units: IGCC Class CBA when tested according to ASTM E2188, ASTM E2189, ASTM E2190; dual sealed unit with primary polyisobutylene seal, secondary silicone seal and 1/2" airspace. Glass edges shall be clean scored and cut.
   1. Provide Fully Tempered glass where indicated per glass types.

C. Fully Tempered Clear Glass: ASTM C1048 Type I, Class 1, q3, Kind FT, horizontally tempered; 1/4" thick unless noted otherwise.

D. Heat-Strengthened Float Glass: ASTM C1036, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear), Quality-Q3.

E. Clear Float Glass: ASTM C1036, Type I, Class 1, q3; 1/4" thick unless noted otherwise.

F. Laminated Glass: ASTM C1172, and complying with testing requirements in 16 CFR 1201 for category II Materials. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
   1. Construction: Laminate glass with polyvinyl butyral interlayer as specified per glass type.
   2. Interlayer Thickness: Provide thickness not less than indicated in glass type.
   3. Interlayer Color: Clear unless otherwise indicated.

G. Spacer Bar and hermetic seal requirements:
   1. Hermetic seal to consist of Polyisobutylene (Butyl) Primarily and Silicone Secondary seal. Primary and Secondary seals shall be uniform and continuous. Hermetic seals shall also meet the following requirements:
      a. Secondary seal shall extend from exterior face of inner glass pane to interior face of exterior glass pane and shall not contain any of the contaminants or imperfections described below.
      b. Primary seal shall not contain fingerprints, dirt, debris, or any other contaminants or interruptions that may affect adhesion or continuity of the seal.
      c. Primary seal shall not be reduced to less than 1/8” in width at any point along the perimeter of the Insulated Glass Unit or 1/32” in thickness (side spacer shall not be visible through a “transparent” layer of thin primary seal)
      d. Primary and secondary seal shall not contain voids and must be continuously bonded to the surface of the glass.
      e. Units shall carry CBA Rating as established by ASTM E774 and shall have an initial frost point less than -60 degrees F when tested per ASTM E576.

H. Solar Control Film: Where Glass type is followed by a "T" (e.g. G-1T), apply Solar Film as specified in section 08 87 13 - Solar Control Film.

2.02 INSULATED GLASS UNITS

A. Solar Control Coated, Low E Insulating Clear Glass (G-1)
   1. Basis of Design Product: Vitro Architectural Glass (formerly PPG)
   2. Overall Unit Thickness: 1”
   3. Indoor Lite: 1/4” clear float glass.
   4. 1/2” Airspace.

5. Outdoor Lite: 1/4” clear glass.
6. Low E coating: Installed on second surface (#2)
    a. Solarban 70 Solar Control Low-E by Vitro Architectural Glass (formerly PPG)

B. Solar Control Coated, Low E Insulating Clear – Fully Tempered Glass (G-2)
1. Basis of Design Product: Vitro Architectural Glass (formerly PPG)
2. Overall Unit Thickness: 1”
3. Indoor Lite: 1/4" thick clear, fully tempered glass.
4. 1/2” Airspace.
5. Outdoor Lite: 1/4" thick clear, fully tempered glass.
6. Low E coating: Installed on second surface (#2)
    a. Solarban 70 Solar Control Low-E by Vitro Architectural Glass (formerly PPG)

C. Insulating Spandrel Glass (G-3)
1. Basis of Design Product: Oldcastle Insulating Glass.
2. Overall Unit Thickness: 1”
3. Indoor Lite: 1/4" thick clear fully tempered glass.
    a. Coating: Harmony Solex Spandrel on fourth surface (#4)
4. 1/2” Airspace.
5. Outdoor Lite: 1/4" thick clear heat-strengthened float glass.

D. Insulating Frosted Glass (G-9)
1. Basis of Design Product: Vitro Architectural Glass (formerly PPG)
2. Overall Unit Thickness: 1”
3. Indoor Lite: Two (2) pieces 1/8" thick Clear Float Glass, laminated.
    a. Interlayer Thickness: 0.030”
    b. Interlayer Color: White frosted; “Arctic Snow” by Oldcastle or equivalent.
4. 1/2” Airspace Outdoor Lite: 1/4" thick clear float glass.
5. Low E coating: Installed on second surface (#2)
    a. Solarban 70 Solar Control Low-E by Vitro Architectural Glass (formerly PPG)

E. Insulating Frosted Safety Glass (G-10)
1. Basis of Design Product: Oldcastle Insulating Glass.
2. Overall Unit Thickness: 1”
3. Indoor Lite: Two (2) pieces 1/8" thick Clear Float Glass, laminated.
    a. Interlayer Thickness: 0.030”
    b. Interlayer Color: White frosted; “Arctic Snow” by Oldcastle or equivalent.
4. 1/2” Airspace.
5. Outdoor Lite: 1/4" thick clear fully tempered glass.

F. Insulating Fully Tempered Safety Glass (G-11)
1. Basis of Design Product: Oldcastle Insulating Glass.
2. Overall Unit Thickness: 1”
3. Indoor Lite: 1/4" thick clear fully tempered glass.
4. 1/2” Airspace.
5. Outdoor Lite: 1/4" thick clear fully tempered glass.

G. Insulating Fully Tempered Spandrel Glass (G-13)
1. Basis of Design Product: Oldcastle Insulating Glass.
2. Overall Unit Thickness: 1”
3. Indoor Lite: 1/4" thick clear fully tempered glass.
    a. Coating: Harmony Solex Spandrel on fourth surface (#4)
4. 1/2” Airspace.
5. Outdoor Lite: 1/4" thick clear fully tempered glass.

H. Insulating Clear Glass (G-14)
1. Basis of Design Product: Oldcastle Insulating Glass.

2. Overall Unit Thickness: 1”
3. Indoor Lite: 1/4" thick clear float glass.
4. 1/2” Airspace.
5. Outdoor Lite: 1/4" thick clear float glass.

2.03 MONOLITHIC GLASS UNITS

A. Clear Float Glass (G-4)
   1. 1/4" thick clear float glass.

B. Clear Fully Tempered Glass (G-5)
   1. 1/4" thick clear fully tempered glass.

C. Clear Fully Tempered Glass (G-5A)

D. Laminated Safety Glass (G-6)
   1. Overall Unit Thickness: 1/2”
   2. Two (2) pieces of 1/4” clear float glass, laminated.
      a. Polished glass edges.
   3. Interlayer Thickness: 0.030”
   4. Interlayer Color: Clear.

E. Frosted Laminated Safety Glass (G-7)
   1. Overall Unit Thickness: 1/4"
   2. Two (2) pieces of 1/8” clear float glass, laminated.
      a. Polished glass edges.
   3. Interlayer Thickness: 0.030”
   4. Interlayer Color: “Arctic Snow” by Oldcastle or equivalent.

F. Acid-Etched, Fully Tempered Glass (G-8) (Shower Doors)
   1. 3/8” thick fully tempered glass.
   2. One Side polished: Polished side shall face interior of shower stall.
   3. One Side Acid-Frosted, obscure.

G. Clear Tempered Glass with Digitally Printed Pattern: (G-12)
   1. Basis of Design Product: Skyline Design “Light & Shadow.”
   2. 1/4” Clear fully tempered glass.
   3. Pattern:
      a. Side 1: No pattern (Whirlpool side)
      b. Side 2: Light & Shadow Cascade Opt A Pattern Eco-etched (Locker room side)
   4. Panel Size: Refer to drawing details.
   5. Frame: Stylmark Frame # 110361 with Brushed Brite Brown #216 finish.
   6. Note: Long lead time item. Coordinate with manufacturer and tile installer.

H. Clear Fully Tempered, Laminated Glass (Glass Guard Rail, typ) (G-15)
   1. Type 1, Clear Laminated Glass, 2 layers. Polyvinyl Butyl (PVB) interlayer.
      a. Interlayer Thickness: 0.030” min.
      b. Total thickness as required by structural load, but not less than 1/2" (12 mm)
   2. Meets or exceeds ASTM E2358.

I. Fully Tempered Clear Glass (G-16)
   1. Glass: Tempered float glass meeting requirements of ASTM C1036, Type I, Quality Q3, fully tempered in accordance with ASTM C1048, Kind FT.
   2. Thickness: 1/2"

J. Frosted Fully Tempered, Laminated Glass (Glass Guard Rail as indicated) (G-17)
   1. Type 1, Clear Laminated Glass, 2 layers. Frosted Polyvinyl Butyl (PVB) interlayer.
      a. Interlayer Thickness: 0.030” min.
      b. Interlayer Color: "Arctic Snow" by Oldcastle, Viracon, or equivalent.
      c. Total thickness as required by structural load, but not less than 1/2" (12 mm)

2. Meets or exceeds ASTM E2358.

2.04 UNFRAMED MIRROR GLASS AND TRIM

A. Unframed Mirror Glass: GSA CID A-A-3002, 1/4" thick. Provide fully adhered mirrors where mirror glass extends to within 18” of the floor. Comply with ASTM C1503. Provide pencil polished edge treatment at vertical butt joints. Miter mirror glass at inside corners.
   1. Safety Glass: Where required by code, glass shall be laminated and heat-strengthened. Laminated and heat-strengthened glass shall conform to ASTM C1048 (for heat-strengthened glass) and ASTM C1172 (for laminate glass) and the following requirements:
      a. Consumer Product Safety Commission Standard 16 CFR 1201.
      b. Safety Certification council.
      c. ANSI Z97.1
      d. Local Codes, whichever is most stringent.
   2. Safety Tape: Where Safety Glass is not otherwise required, provide and install safety tape backing at all Unframed Mirror Glass.
      a. Basis of Design: C.R. Laurence, CRL White Category II Shatterproof Safety Tape for Mirrors; Sized as required.

B. Mirror Types:
   1. MIR-1:
      a. Tint: None
      b. Location: Typical unless noted otherwise.
   2. MIR-2:
      a. Tint: Gray
      b. Location: Yoga, MB360 and Yoga Foyer
   3. MIR-3:
      a. Tint: Bronze
      b. Location: Columns as indicated.

C. Unframed Mirror J Molding:
   1. Product: Stylmark, Inc. 420107.
   2. Locations:
      a. At multiple piece mirrors: Top, bottom and outside corner terminations.
      b. At single piece mirrors: Top, bottom and both sides.
   3. Size: J-molding (5/8”) or equal.
   4. Finish:
      a. Typical: No. 128 Buffed Satin Stainless Steel.
      b. Group Fitness, Barre, Cycle & ADA Mirrors: 22BRN80049.
      c. Or approved equal.
   5. Miter all corners.

D. Unframed Mirror Mastic: Provide MDI polymer based, low VOC mirror mastic compliant with SCAQMD 1168 rule 51< 250 g/L
   1. CRL Palmer Mirro-Mastic.
   2. Or approved equal.

E. Double-Sided Mirror Divider:
   1. Product: Stylmark, 510000X031.
   2. Color: #216 Brushed Brite Brown.
   3. Location: Locker Room Vanities.

F. Backlit mirror edge:
   1. Product: Stylmark Angle 110728
   2. Location: Pilates, Yoga, Yoga Foyer
   3. Color: 22BRN80049

2.05 GLAZED FOOD SERVICE FIXTURES

A. Sneeze Guard:
   1. Glazing:
      a. 1/4" Fully Tempered Glass (G-5).
      b. Ease all exposed edges.
      c. Miter corners.
      d. Panel sizes:
         1) See drawings.
   2. Metal Structure:
      a. Manufacturer: Stylmark.
      b. 1" x 1" Sill.
      c. Part Number: 110361.
      d. Hardware: As necessary for field assembly.
      e. Color: All metal components: 216 Brushed Brite Brown.
      f. Anchors: Coordinate with Casework. See details.

2.06 DECORATIVE CAST GLASS

A. Tempered, Tinted,Kiln formed decorative glass (G-21)
   1. Manufacturer: Nathan Allan Glass Studios.
   2. Series: Channel.
   3. Tint: Bronze.
   4. Thickness: 3/8"
   5. Size: See Drawings.
   6. URL: https://www.nathanallan.com/glass-types-bronze-black/

2.07 GLAZING ACCESSORIES AS RECOMMENDED IN GANA GLAZING MANUAL

A. Silicone Glazing Sealant: Specified in Section 07 92 00 - Joint Sealers. Ensure compatibility with silicone.

B. Setting Blocks: Neoprene; 80-90 Shore A durometer hardness. Ensure compatibility with silicone.

C. Edge Blocks/Shims: Neoprene; 60-70 Shore A durometer hardness. Ensure compatibility with silicone.

D. Glazing Tape: Preformed butyl compound coiled on release paper; properly sized for application, black/bronze color. Tremco, 440 Tape. Ensure compatibility with silicone.

E. Glazing Clips: Manufacturer's standard type. Ensure compatibility with silicone.

PART 3 EXECUTION

3.01 INSPECTION

A. Verify surfaces of glazing channels or recesses are clean, free of obstructions, and ready for work of this Section.

B. Beginning of installation means acceptance of substrate.

3.02 ALUMINUM, ENTRANCES, STOREFRONTS AND CURTAIN WALL SYSTEM

A. Glaze aluminum entrances and storefronts and curtain wall system in accordance with manufacturer's glazing instructions.

3.03 INTERIOR COMBINATION METHOD (TAPE AND SEALANT)

A. Cut glazing tape to length and install against permanent stops, projecting 1/16" above sightline.

B. Place setting blocks at quarter points.

C. Rest glass on setting blocks and push against tape to ensure full contact at perimeter of pane.

D. Install removable stops, spacer shims inserted between glass, and applied stops at 24" intervals, 1/4" below sightline.

E. Fill gap between pane and applied stop with silicone sealant to depth equal to bite of frame on pane to uniform and level line.

F. Trim protruding tape edge.

3.04 UNFRAMED MIRROR GLASS

A. Install Safety Tape at all non-safety unframed mirror glass in accordance with safety tape manufacturer’s instructions.

B. Install tape in shop environment prior to delivering to site whenever possible.

C. Hold tape edges back from edge of mirror sufficient to prevent visibility after installation.

3.05 CLEANING

A. After installation, mark pane with an "X" by using plastic tape or removable paste.

B. Remove glazing materials from finish surfaces.

C. Remove labels after work is completed.

END OF SECTION

SECTION 08 87 13
SOLAR CONTROL FILM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Solar control film applied to glass.

1.02 RELATED SECTIONS

A. Section 01 33 00 - Submittal Procedures.

B. Section 01 40 00 - Quality Requirements.

C. Section 01 60 00 - Product Requirements.

D. Section 08 41 13 - Aluminum Framed Entrances and Storefronts.

E. Section 08 44 13 - Glazed Aluminum Curtainwall.

F. Section 08 81 00 - Glazing.

1.03 REFERENCES

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

B. ISO 9001 - Quality Management Systems — Requirements; 2015, with Amendment (2024).

C. ISO 14001 - Environmental Management Systems — Requirements with Guidance for Use; 2015.

D. LBNL WINDOW SOFTWARE - A computer program for calculating total window thermal performance indices (i.e. U-values, solar heat gain coefficients, and visible transmittances).

E. NFRC 100/200 - Standard Methods of Test for Solar Absorbance, Reflectance and Transmittance of Materials Using Integrating Spheres.

1.04 PERFORMANCE REQUIREMENTS

A. Flammability: Meets surface burning characteristics in accordance with ASTM E84 Class A
   1. Flame Spread Index = < 25
   2. Smoke Development Index = < 450

B. Volatile Organic Compound Content:
   1. Compliant with the performance standard established for low-emitting materials under the CDPH, the Collaborative for High Performance Schools (CHPS) and the LEED v4 programs.

1.05 SUBMITTALS

A. Submit under provisions of Section 01 30 00.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Physical properties and independent testing agency reports showing compliance with specified tests.
   2. Preparation instructions and recommendations.
   3. Storage and handling requirements and recommendations.
   4. Installation methods.

C. Shop Drawings: Detailing installation of film, anchoring accessories, and/or sealant.

D. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square, representing the actual product, color, and patterns.

E. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

F. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.
   3. See Sections 01 33 00 and 01 60 00.

G. Manufacturer's warranty information.

1.06 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Manufacturer Qualifications: Products specified shall be a standard product of a manufacturer regularly engaged in the manufacturing and distribution of such products for a minimum of 10 years.
   1. Provide a Quality Management certificate stating the manufacturing facility's location conformance with ISO 9001.
   2. Provide an Environmental Management certificate stating the manufacturing facility's location conformance with ISO 14001.

C. Installer Qualifications: Documented experience in the application of self-adhesive window films with at least 3 applications of similar size and complexity, and approved by the solar film manufacturer.

1.07 DELIVERY, STORAGE AND HANDLING

A. Store products indoors in manufacturer's unopened packaging until ready for installation.

1.08 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.09 WARRANTY

A. Provide film manufacturer's limited warranty against failure of film, including peeling, bubbling, rippling, cracking, delamination and demetallization; includes cost of material and labor for removal and reinstallation. Duration of warranty shall be as follows:
   1. Twelve (12) Year Limited Warranty.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturer: Solar Gard®, which is located at: 4540 View Ridge Ave.; San Diego, CA 92123; Toll Free Tel: 866-572-1922; Tel: 858-576-0200; Email: info@solargard.com; Web:www.solargard.com

B. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00.

2.02 SOLAR CONTROL FILM

A. For use in indoor Pickleball areas, where indicated.
   1. Solar Gard TrueVue 5 solar control film shall have the following nominal properties when applied to 1/4 inch (6 mm) clear glass with pressure sensitive adhesive calculated using NFRC methodology and LBNL Window software.
      a. Film Performance Results, Nominal
         1) Film Color: Grey
         2) Visible Light Transmittance: 5 percent
         3) Visible Light Reflectance: (Exterior) 44 percent
         4) Visible Light Reflectance: (Interior) 8 percent
         5) Total Solar Energy Rejected: 79 percent
         6) Solar Heat Gain Coefficient: .21
         7) U-Factor Btu/h-ft² F (Winter): .98
         8) Solar Transmittance: 5 percent
         9) Solar Absorptance: 54 percent
         10) Solar Reflectance: 41 percent
         11) Ultraviolet Light Blocked (300-380 nanometers): > 99 percent
         12) UV Tdw-ISO @ 300 to 700 nm: 4 percent

B. For use in other indicated areas.

1. Solar Gard TrueVue 15 solar control film shall have the following nominal properties when applied to 1/4 inch (6 mm) clear glass with pressure sensitive adhesive calculated using NFRC methodology and LBNL Window software.
    a. Film Performance Results, Nominal
        1) Film Color: Grey
        2) Visible Light Transmittance: 15 percent
        3) Visible Light Reflectance: (Exterior) 44 percent
        4) Visible Light Reflectance: (Interior) 23 percent
        5) Total Solar Energy Rejected: 77 percent
        6) Solar Heat Gain Coefficient: .23
        7) U-Factor Btu/h-ft² F (Winter): .98
        8) Solar Transmittance: 8 percent
        9) Solar Absorptance: 51 percent
        10) Solar Reflectance: 41 percent
        11) Ultraviolet Light Blocked (300-380 nanometers): > 99 percent
        12) UV Tdw-ISO @ 300 to 700 nm: 10 percent

PART 3 EXECUTION

3.01 EXAMINATION

A. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

B. Glass surfaces should be inspected for defects including scratches or defects which will affect the final appearance.

C. Do not begin installation until substrates have been properly inspected.

D. Coordinate location of windows where film is to be installed with Drawings and Architect.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions. Installation must be accomplished by a recognized professional installer of film for energy control purposes or safety and security purposes. Completed work must meet IWFA visual acceptance standard.

B. Install without bubbles, ripples, drips, dirt, cuts, tears or gaps between film and frame.

C. Clean newly installed film and window frames after installation.

D. Clean up cleaning solutions, run-off cleaning water and adhesive mounting solution.

3.04 PROTECTION

A. Protect installed products until completion of project.

B. Where installed film could be damaged by subsequent construction provide tape warning strips or barricades to prevent contact.

END OF SECTION

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SECTION 09 05 61
COMMON WORK RESULTS FOR FLOORING PREPARATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This section applies to floors identified in Contract Documents that are receiving the following types of floor coverings:
   1. Resilient flooring.
   2. Resinous flooring.
   3. Carpet tile.
   4. Wood Athletic Flooring.
   5. Ceramic tile and stone tile.

B. Preparation of new concrete floor slabs for installation of floor coverings.

C. Testing of concrete floor slabs for moisture and alkalinity (pH).

D. Remediation of concrete floor slabs due to unsatisfactory moisture or alkalinity (pH) conditions.
   1. Contractor shall perform all specified remediation of concrete floor slabs. If such remediation is indicated by testing agency's report and is due to a condition not under Contractor's control or could not have been predicted by examination prior to entering into the contract, a contract modification will be issued.

E. Patching compound.

F. Remedial floor coatings.

G. Remedial floor sheet membrane.

1.02 RELATED REQUIREMENTS

A. Section 01 22 00 - Unit Prices: Bid pricing for remediation treatments if required.

B. Section 01 40 00 - Quality Requirements: Additional requirements relating to testing agencies and testing.

C. Section 01 84 21 - Interior Concrete Floor Finishing Quality Requirements.

D. Section 03 30 00 - Cast-in-Place Concrete: Concrete compostition, curing, tolerances and admixtures.

E. Section 09 30 00 - Tiling.

F. Section 09 64 66 - Wood Athletic Flooring.

G. Section 09 65 19 - Resilient Flooring.

H. Section 09 67 23 - Resinous Flooring.

I. Section 09 68 13 - Tile Carpeting.

1.03 PRICE AND PAYMENT PROCEDURES

A. Unit Prices: See Section 01 22 00 - Unit Prices.

B. Unit Price for Alternate Flooring Adhesive: Do not include the cost of the alternate adhesive in the base bid; state on the bid form the unit price per square foot (square meter) for using the alternate adhesive, in the event such remediation is required.

C. Unit Price for Remedial Floor Coating or Sheet Membrane: Do not include the cost of the floor coating or underlayment in the base bid; state on the bid form the unit price per square foot (square meter) for the floor coating or underlayment, installed, in the event such remediation is required.

1.04 REFERENCE STANDARDS

A. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 50 mm [2 in.] Cube Specimens); 2023.

B. ASTM C472 - Standard Test Methods for Physical Testing of Gypsum, Gypsum Plasters, and Gypsum Concrete; 2020.

C. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2022.

D. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2023.

E. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.

F. ASTM F3311 - Standard Practice for Mat Bond Evaluation of Performance and Compatibility for Resilient Flooring System Components Prior to Installation; Current Edition.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordinate scheduling of cleaning and testing, so that preliminary cleaning has been completed for at least 24 hours prior to testing.

1.06 SUBMITTALS

A. Floor Covering and Adhesive Manufacturers' Product Literature: For each specific combination of substrate, floor covering, and adhesive to be used; showing:
   1. Moisture and alkalinity (pH) limits and test methods.
   2. Manufacturer's required bond/compatibility test procedure.

B. Testing Agency's Report:
   1. Description of areas tested; include floor plans and photographs if helpful.
   2. Summary of conditions encountered.
   3. Temperature:
      a. Ambient Air
      b. Substrate Surface
   4. Moisture and alkalinity (pH) test reports.
   5. Surface Porosity.
   6. Subfloor Flatness.
   7. Copies of specified test methods.
   8. Recommendations for remediation of unsatisfactory surfaces.
   9. Product data for recommended remedial coating.
   10. Submit report to Architect.
   11. Submit report not more than two business days after conclusion of testing.

C. Adhesive Bond and Compatibility Test Report. (ASTM F3311-19)

1.07 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Moisture and alkalinity (pH) testing shall be performed by an independent testing agency employed and paid by Contractor.

C. Testing Agency Qualifications: Independent testing agency experienced in the types of testing specified.
   1. Submit evidence of experience consisting of at least 3 test reports of the type required, with project Construction Manager's project contact information.

D. Contractor's Responsibility Relating to Independent Agency Testing:
   1. Provide access for and cooperate with testing agency.
   2. Confirm date of start of testing at least 10 days prior to actual start.
   3. Allow at least 4 business days on site for testing agency activities.
   4. Achieve and maintain specified ambient conditions.
   5. Notify Architect when specified ambient conditions have been achieved and when testing will start.

1.08 FIELD CONDITIONS

A. Maintain ambient temperature in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 65 degrees F (18 degrees C) or more than 85 degrees F (30 degrees C).

B. Maintain relative humidity in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 40 percent and not more than 60 percent.

PART 2 PRODUCTS

2.01 MATERIALS

A. Patching Compound: Floor covering manufacturer's recommended product, suitable for conditions, and compatible with adhesive and floor covering. In the absence of any recommendation from flooring manufacturer, provide a product with the following characteristics:
   1. Cementitious moisture-, mildew-, and alkali-resistant compound, compatible with floor, floor covering, and floor covering adhesive, and capable of being feathered to nothing at edges.
   2. Compressive Strength: 3000 psi, minimum, after 28 days, when tested in accordance with ASTM C109/C109M or ASTM C472, whichever is appropriate.
   3. Products:
      a. TEC, an H.B. Fuller Construction Products Brand; TEC Feather Edge Skim Coat: www.tecspecialty.com/#sle.
      b. USG Corporation; Durock Brand Advanced Skim Coat Floor Patch: www.usg.com/#sle.
      c. Substitutions: See Section 01 60 00 - Product Requirements.

B. Alternate Flooring Adhesive: Floor covering manufacturer's recommended product, suitable for the moisture and pH conditions present; low-VOC. In the absence of any recommendation from flooring manufacturer, provide a product recommended by adhesive manufacturer as suitable for substrate and floor covering and for conditions present.

C. Remedial Floor Coating: Single- or multi-layer coating or coating/overlay combination intended by its manufacturer to resist water vapor transmission to degree sufficient to meet flooring manufacturer's emission limits, resistant to the level of alkalinity (pH) found, and suitable for adhesion of flooring without further treatment.
   1. Thickness: As required for application and in accordance with manufacturer's installation instructions.
   2. Use product recommended by testing agency.

D. Remedial Floor Sheet Membrane: Pre-formed multi-ply sheet membrane installed over concrete subfloor and intended by its manufacturer to resist water vapor transmission to degree sufficient to meet flooring manufacturer's emission limits, resistant to the level of alkalinity (pH) found, and suitable for adhesion of flooring without further treatment.
   1. Thickness: 28 mil (0.028 inch) (0.711 mm).
   2. Tape: Types recommended by underlayment manufacturer to install membrane and cover seams.

PART 3 EXECUTION

3.01 CONCRETE SLAB PREPARATION

A. Follow recommendations of testing agency.

B. Perform following operations in the order indicated:
   1. Preliminary cleaning.
   2. Moisture vapor emission tests; 3 tests in the first 1000 square feet (100 square meters) and one test in each additional 1000 square feet (100 square meters), unless otherwise indicated or required by flooring manufacturer.
   3. Internal relative humidity tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
   4. Alkalinity (pH) tests; in same locations as moisture vapor emission tests, unless otherwise indicated.

5. Specified remediation, if required.
6. Patching, smoothing, and leveling, as required.
7. Other preparation specified.
8. Adhesive bond and compatibility test.
9. Protection.

C. Remediations:
1. Active Water Leaks or Continuing Moisture Migration to Surface of Slab: Correct this condition before doing any other remediation; re-test after correction.
2. Excessive Moisture Emission or Relative Humidity: If an adhesive that is resistant to the level of moisture present is available and acceptable to flooring manufacturer, use that adhesive for installation of the flooring; if not, apply remedial floor coating or remedial sheet membrane over entire suspect floor area.
3. Excessive Alkalinity (pH): If remedial floor coating is necessary to address excessive moisture, no additional remediation is required; if not, if an adhesive that is resistant to the level present is available and acceptable to the flooring manufacturer, use that adhesive for installation of the flooring; otherwise, apply a skim coat of specified patching compound over entire suspect floor area.

3.02 PRELIMINARY CLEANING

A. Clean floors of dust, solvents, paint, wax, oil, grease, asphalt, residual adhesive, adhesive removers, film-forming curing compounds, sealing compounds, alkaline salts, excessive laitance, mold, mildew, and other materials that might prevent adhesive bond.

B. Do not use solvents or other chemicals for cleaning.

3.03 MOISTURE VAPOR EMISSION TESTING

A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.

B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.

C. Test in accordance with ASTM F1869 and as follows.

D. Plastic sheet test and mat bond test may not be substituted for the specified ASTM test method, as those methods do not quantify the moisture content sufficiently.

E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if test values exceed 3 pounds per 1000 square feet (1.4 kg per 93 square meters) per 24 hours.

F. Report: Report the information required by the test method.

3.04 INTERNAL RELATIVE HUMIDITY TESTING

A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.

B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.

C. Test in accordance with ASTM F2170 Procedure A and as follows.

D. Testing with electrical impedance or resistance apparatus may not be substituted for the specified ASTM test method, as the values determined are not comparable to the ASTM test values and do not quantify the moisture content sufficiently.

E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if any test value exceeds 75 percent relative humidity.

F. Report: Report the information required by the test method.

3.05 ALKALINITY TESTING

A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.

B. The following procedure is the equivalent of that described in ASTM F710, repeated here for the Contractor's convenience.
   1. Use a wide range alkalinity (pH) test paper, its associated chart, and distilled or deionized water.
   2. Place several drops of water on a clean surface of concrete, forming a puddle approximately 1 inch (25 mm) in diameter. Allow the puddle to set for approximately 60 seconds, then dip the alkalinity (pH) test paper into the water, remove it, and compare immediately to chart to determine alkalinity (pH) reading.
   3. Use of a digital pH meter with probe is acceptable; follow meter manufacturer's instructions.

C. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if alkalinity (pH) test value is over 10.

3.06 PREPARATION

A. See individual floor covering section(s) for additional requirements.

B. Comply with requirements and recommendations of floor covering manufacturer.

C. Correction of uneven concrete surface.
   1. Grind high spots down.
   2. Fill and smooth surface cracks, grooves, depressions, control joints and other non-moving joints, and other irregularities with patching compound.
   3. Do not fill expansion joints, isolation joints, or other moving joints.
   4. Prepared surfaces shall conform to the levelness requirements of the floor covering manufacturer, or no more than 3/16."

3.07 ADHESIVE BOND AND COMPATIBILITY TESTING

A. Comply with requirements and recommendations of floor covering manufacturer.

3.08 APPLICATION OF REMEDIAL FLOOR COATING

A. Comply with requirements and recommendations of coating manufacturer.

3.09 INSTALLATION OF REMEDIAL FLOOR SHEET MEMBRANE

A. Install in accordance with sheet membrane manufacturer's instructions.

3.10 PROTECTION

A. Cover prepared floors with building paper or other durable covering.

END OF SECTION

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SECTION 09 21 16
GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes the following:
   1. Interior gypsum board.
      a. Standard Gypsum Board.
      b. Type X.
      c. Type C.
      d. Flexible Type.
      e. High Impact Type.
      f. Moisture Resistant Type.
      g. Glass Mat Sheathing.
   2. Tile backing panels.
      a. Glass Mat Backing Panels.
      b. Cementitious Backing Panels.
   3. Exterior sheathing.
   4. Interior framing systems (e.g., supports for partition walls, framed soffits, furring, canopies, etc.).
   5. Interior suspension systems (e.g., supports for ceilings, suspended soffits, etc.).
   6. Isolated ceiling system (e.g. engineered gypsum board system)
   7. Partition gap closure accessories (between partition and curtain wall)

1.02 RELATED SECTIONS

A. Section 01 31 00 - Project Management and Coordination.

B. Section 01 33 00 - Submittal Procedures.

C. Section 01 40 00 - Quality Requirements.

D. Section 01 60 00 - Product Requirements.

E. Section 05 12 00 - Structural Steel Framing.

F. Section 05 31 00 - Steel Decking.

G. Section 05 40 00 - Cold-Formed Metal Framing.

H. Section 06 10 00 - Rough Carpentry.

I. Section 07 81 00 - Applied Fireproofing.

J. Section 07 81 60 - Intumescent Fireproofing.

K. Section 07 84 00 - Firestopping.

L. Section 07 92 00 - Joint Sealants.

M. Section 08 31 13 - Access Doors and Frames.

1.03 REFERENCE STANDARDS

A. AISI American Iron and Steel Institute; LRFD Design Manual.

B. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2023.

C. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 2023.

D. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

E. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire; 2019.

F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

G. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members; 2015.

H. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus; 2019.

I. ASTM C365/C365M - Standard Test Method for Flatwise Compressive Properties of Sandwich Cores; 2022.

J. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2017 (Reapproved 2022).

K. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2018.

L. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2023.

M. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2020.

N. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2023.

O. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications; 2022.

P. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2022.

Q. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2022.

R. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base; 2019.

S. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2017.

T. ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel; 2018.

U. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.

V. ASTM C1629/C1629M - Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels; 2023.

W. ASTM D226/D226M - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing; 2017 (Reapproved 2023).

X. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.

Y. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

Z. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.

AA. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.

BB. ASTM E413 - Classification for Rating Sound Insulation; 2022.

CC. ASTM E488/E488M - Standard Test Methods for Strength of Anchors in Concrete Elements; 2022.

DD. ASTM E1190 - Standard Test Methods for Strength of Power-Actuated Fasteners Installed in Structural Members; Current edition.

1.04 PERFORMANCE REQUIREMENTS

A. Performance: Provide cold-formed metal framing capable of withstanding design loads within limits and under conditions indicated.

1. All non-structural steel framing members, including studs and runners shall meet the requirements of ASTM C645.
    a. Provide galvanized coatings on all members consistent with ASTM and industry standards and as otherwise specified.
2. Construct typical walls and framing in accordance to ASTM C754 Applying the design criteria below.
3. Design Loads (use governing load cases):
    a. 5 psf differential pressure (IBC 1607.13) minimum.
    b. As indicated on drawings.
    c. Seismic loading per ASCE 7, Chapter 13, and section 13.5.8, for Seismic Design Categories C, D, E and F. See Architectural Drawings Sheet G003 for Seismic Design Category designation.
    d. 12 psf dead load for ceilings with rigid finishes (tile or wood)
4. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
    a. Interior Wall Framing: Design wall framing to meet the following horizontal deflection conditions:
        1) Typical Conditions: L/180 of wall height.
        2) IFS Finishes: L/360 of wall height.
        3) Rigid Finishes Wall and Ceiling (Tile): L/240
        4) Headers: Vertical deflection of L/240 or ½" max
5. Jamb studs around openings shall be capable of resisting tributary load applied from supporting members using common engineering practices. The deflection criteria for the jamb member shall meet or exceed L/120.
6. Walls with gypsum board on both sides full height are to be sized using the Maximum Stud Height tables in ASTM C754.
7. Walls without gypsum board on both sides full height shall have horizontal bridging or blocking per manufacturer instructions.
8. The use of powder activated fasteners to make connection to precast concrete is allowed with manufacturer approval through a fastener testing program. In some cases, the precast concrete produced achieves greater concrete compressive strengths than allowed by the powder activated manufacturer specification.
9. Provide soffit bracing to resist loading requirements specified.
10. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
    a. Floors: Upward and downward movement of 1.0 inch (25 mm).
    b. Roof – Typ: Upward and downward movement of 1.5 inch (38 mm)
    c. Roof – Long Span Tees (> 50 ft): Upward movement of 1.5 inch and downward movement of 3.0 inch (75 mm)
11. Field conditions observed by the Architect, Engineer, or building official deemed to be unacceptable shall be reviewed by a qualified professional engineer hired by the light gauge installer at no additional cost to the owner. Conditions in question will require engineered design prepared by a qualified professional engineer registered in the jurisdiction where the project is located to validate the existing design or corrective actions required to meet project specifications.

1.05 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Submit fabrication and erection shop drawings for approval prior to fabrication of framing. Indicate details of connections or welds, and manufacturer of connections.

C. Certified Shop (erection) Drawings: Submit signed and certified fabrication and erection Shop Drawings for approval prior to fabrication for framing components subject to seismic loading per ASCE 7, Chapter 13, and section 13.5.8 (Seismic Design Categories C, D, E, F), and for any additional components as indicated on drawings as "Engineered by Fabricator".

1. Show layout, spacing, sizes, thicknesses and types of cold-formed metal framing, fabrication and fastening and anchorage details, including mechanical fasteners. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details and attachment to adjoining work.
2. Provide complete design calculations for each part of system and each condition including studs, runner channels, hangers and fasteners.

D. Submit certification that all steel components meet specified galvanization or alternate coatings as specified.

E. Procurement:
1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
2. Submit inventory to Owner within 5 days of delivery of materials.
3. See Sections 01 33 00 and 01 60 00.

F. Qualification Data: for professional engineer.

1.06 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Engineering Responsibility: Preparation of shop drawings, design calculations and other structural data by a qualified professional engineer.

C. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of cold-formed metal framing that are similar to those indicated for this Project in material, design, and extent.

D. Design Confirmation: For items indicated as “Engineered by Fabricator” provide letter of confirmation that the work of this section has been designed by a qualified professional engineer registered in the jurisdiction where the project is located.

E. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.

F. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

1.07 STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other causes. Stack panels flat to prevent sagging.

1.08 PROJECT CONDITIONS

A. Environmental Limitations: Comply with ASTM C840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

B. Do not install interior products until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.
1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 PRODUCTS

2.01 PANELS, GENERAL

A. Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.02 INTERIOR GYPSUM BOARD

A. General: Complying with ASTM E84 and ASTM C365/C365M or ASTM C1396/C1396M as applicable to type of gypsum board indicated and whichever is more stringent.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. American Gypsum Co.
      b. G-P Gypsum.
      c. National Gypsum Company.
      d. USG Corporation.
      e. PABCO Gypsum.
      f. CertainTeed Corp.

B. Standard Gypsum Board: Use where no more stringent requirements are called for.
   1. Thickness 5/8."
   2. Long Edges: Tapered.
   3. Surfaced with paper on front, back and long edges.

C. Type X:
   1. Thickness: 5/8 inch (15.9 mm).
   2. Fire resistance rating: ASTM 1396; 1hr per 5/8" thickness.
   3. Long Edges: Tapered.

D. Type C:
   1. Thickness: As required by fire-resistance-rated assembly indicated on Drawings.
   2. Long Edges: Tapered.

E. Flexible Type: Manufactured to bend to fit radii and to be more flexible than standard regular-type gypsum board of same thickness.
   1. Thickness: 1/4 inch (6.4 mm).
   2. Long Edges: Tapered.

F. High-Impact Type: Manufactured with Type X core, with high impact and mold resistance.
   1. Core: 5/8 inch (15.9 mm) thick.
   2. Reinforcement: Internal Fiberglass mesh or equivalent: Meets or exceeds ASTM C1629/C1629M level 3 for both Hard and Soft body impacts.
   3. Mold Resistance: Meets ASTM D3273 level 10.

G. Moisture- and Mold-Resistant Type: With moisture- and mold-resistant core and surfaces.
   1. Core: 5/8 inch (15.9 mm), Type X.
   2. Mold Resistance: Meets ASTM D3273 level 10.
   3. Long Edges: Tapered.

H. Indoor Pool Room Type: Glass-Mat Gypsum Sheathing Board, ASTM C1177/C1177M.
   1. Product: Subject to compliance with requirements, provide "Dens-Glass Gold" by G-P Gypsum.
   2. 5/8 inch (15.6 mm), regular type.

2.03 TILE BACKING PANELS

A. Glass-Mat, Water-Resistant Backing Board:
   1. Complying with ASTM C1178/C1178M.
      a. Product: Subject to compliance with requirements, provide "DensShield Tile Guard" by G-P Gypsum.
   2. Thickness as shown on drawings.
   3. Fire rating: as shown on drawings.

B. Cementitious Backer Units: ANSI A118.9. (Cement Board)
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Custom Building Products; Wonderboard.
      b. FinPan, Inc.; Util-A-Crete Concrete Backer Board.
      c. USG Corporation; DUROCK Cement Board.
   2. Thickness:
      a. 1/2 inch (12.7 mm) typical.
      b. 5/8 inch at steam room ceilings.

2.04 EXTERIOR GYPSUM BOARD SHEATHING

A. Exterior Gypsum Sheathing: ASTM C1396/C1396M, with manufacturer's standard edges.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. American Gypsum Co.
      b. G-P Gypsum.
      c. National Gypsum Company.
      d. USG Corporation.
   2. Core: 1/2 inch (12.7 mm), regular type.

B. Glass-Mat Gypsum Sheathing Board: ASTM C1177/C1177M.
   1. Product: Subject to compliance with requirements, provide "Dens-Glass Gold" by G-P Gypsum.
   2. 5/8" (15.6 mm), regular type.

2.05 PANEL FASTENERS:

A. Self-drilling, self-tapping steel screws.
   1. For steel framing less than 0.03 inch thick: Comply with ASTM C1002.
      a. For steel framing from 0.033 inch thick to 0.112 inch thick: Comply with ASTM C954.
      b. For wood framing: 8-18 x 0.323 ribbed drywall nail.
      c. Fastener length: for steel min. ¾” over panel thickness; for wood min. 1” over panel thickness.
      d. Corrosion-resistance: Coating to resist rust for a min. of 48 hours per ASTM B117.
      e. Maximum fastener spacing 8” o.c. for vertical surfaces and 6” o.c. for ceilings.

2.06 TRIM ACCESSORIES

A. General Interior Trim: ASTM C1047.
   1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet.
   2. Shapes:
      a. Cornerbead.
      b. Bullnose bead.
      c. LC-Bead: J-shaped; exposed long flange receives joint compound.
      d. L-Bead: L-shaped; exposed long flange receives joint compound.
      e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
      f. Expansion (control) joint.
      g. Curved-Edge Cornerbead: With notched or flexible flanges.

B. General Exterior Trim: ASTM C1047.
   1. Material: Hot-dip galvanized steel sheet, plastic, or rolled zinc.
   2. Shapes:
      a. Cornerbead.
      b. LC-Bead: J-shaped; exposed long flange receives joint compound.
      c. Expansion (Control) Joint: One-piece, rolled zinc with V-shaped slot and removable strip covering slot opening.

C. Reveals and Moldings:
   1. (REG-1) Basis of Design:

a. Manufacturer: Fry Reglet Architectural Metals; https://fryreglet.com/reveals-and-moldings.
1) Substitutions: In accordance with Section 01 60 00 Product Requirements.
b. Product ID: DRM-625-100.
c. Description / Size: 5/8"D x 1"H pre-finished reveal.
d. Finish: Powder Coat, Dark Bronze (factory finished)
e. Location: LT Recover, horizontal datum in Strength Area.
f. Contact: Steve Delvo, stevedelvo@fryreglet.com, (253) 507-6095

D. High Impact Corner Protection:
1. Inpro Architectural Products. "Aluminum Corner Guard"
a. Leg Dimension: 1/2" or as indicated on drawings.
b. Length: as indicated on drawings
c. Finish: Bronze
d. To be used on wall and soffit outside corners where high-impact Gypsum bd is indicated on drawings.
2. Food Service SS Corner Guards: Stainless Steel
a. 16 ga.
b. Leg Dimension: 2"
c. Length: 48"
d. Finish: Plain
e. See drawings for location.
f. See Section 05 50 00 for more information.

2.07 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C475/C475M.

B. Joint Tape:
1. Interior Gypsum Wallboard: Paper.
2. Exterior Gypsum Soffit Board: Paper.
3. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
4. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.
a. Use setting-type compound for installing paper-faced metal trim accessories.
3. Fill Coat: For second coat, use drying-type, all-purpose compound.
4. Finish Coat: For third coat, use drying-type, all-purpose compound.
5. Skim Coat: For final coat of Level 5 finish, use drying-type, all-purpose compound.

D. Joint Compound for Exterior Applications:
1. Exterior Gypsum Soffit Board: Use setting-type taping compound and setting-type, sandable topping compound.
2. Glass-Mat Gypsum Sheathing Board: As recommended by sheathing board manufacturer.

E. Joint Compound for Tile Backing Panels:
1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.
2. Cementitious Backer Units: As recommended by backer unit manufacturer.

2.08 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

C. Steel Drill Screws: ASTM C1002, unless otherwise indicated.
   1. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

D. Sound Attenuation Blankets: ASTM C665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
   1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
   2. See Section 07 21 00 - "Thermal Insulation" for more information.

E. Thermal Insulation: As specified in Section 07 21 00 - "Thermal Insulation.

F. Gypsum Board Adhesives: High performance latex-based construction adhesive designed for gypsum board applications.
   1. Green Series SW-325 Shear & Drywall Adhesive by OSI.
   2. Green Drywall Adhesive by Grabberman.
   3. Or approved Substitution.

G. Acoustical Sealant: Sheetrock Acoustical Sealant by USG or equal.
   1. For gypsum board to gypsum board and gypsum board to structural joints: USG Acoustical Sealant or equal, non-hardening sealant specifically for gypsum board joints.

H. For penetrations at fire-rated construction, provide firestopping as specified in Sections “Firestopping” and “Applied Fireproofing”.

2.09 NON-LOAD-BEARING STEEL FRAMING, GENERAL

A. Recycled Content of Steel Products: Provide products with average recycled content of steel products such that postconsumer recycled content plus one-half of pre-consumer recycled content is not less than 25 percent.

B. Framing Members, General: Comply with ASTM C754 for conditions indicated.
   1. Steel Sheet Components: Comply with ASTM C645 and ASTM A653/A653M requirements for metal, unless otherwise indicated.
   2. Coatings:
      a. General: Provide minimum G40 coating or EQ equivalent on all components except as otherwise indicated.
      b. Provide minimum G90 coating or EQ equivalent on all components within or adjacent to the following areas: Indoor Pool Room and Locker Room Wet Areas, including Showers Areas, Steam Rooms and Whirlpool Suites as indicated on Drawings.

2.10 SUSPENSION SYSTEM COMPONENTS

A. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.0625-inch- (1.59-mm-) diameter wire, or double strand of 0.0475-inch- (1.21-mm-) diameter wire.

B. Hanger Attachments to Concrete:
   1. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching wire hangers and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E488/E488M by an independent testing agency.
      a. Type: Post-installed, expansion anchor.
   2. Powder-Actuated Fasteners: Suitable for application indicated, fabricated from corrosion-resistant materials with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to 10 times that imposed by construction as determined by testing according to ASTM E1190 by an independent testing agency.

C. Sound Isolation Ceiling Hangers:
   1. Provide manufactured Isolation Ceiling Hangers and required components as part of engineered isolation ceiling system indicated on Drawings. Determine appropriate model and accessories required for complete installation.
      a. Manufacturer/Products: Subject to compliance with requirements, provide one of the following:

1) Mason Industries, Inc., “30NCC”; www.Mason-Ind.com.
2) Kinetics Noise Control, “ICC Isolation Hanger”; www.kineticsnoise.com
3) Or approved equal.

D. Sound Isolation Clips:
1. Provide manufactured Isolation Ceiling clips and required components as part of engineered isolation ceiling system indicated on Drawings. Determine appropriate model and accessories required for complete installation.
a. Manufacturer/Products: Subject to compliance with requirements, provide one of the following:
1) PAC International, Inc, “RSIC-1” Sound Isolation Clips; www.pac-intl.com.
2) Kinetics Noise Control, “IsoMax”; www.kineticsnoise.com
3) PLITEQ, “GenieClip”; www.pliteq.com
4) Or approved equal.

E. Wire Hangers: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.162-inch (4.12-mm) diameter.

F. Flat Hangers: Steel sheet, 1 by 3/16 inch (25.4 by 4.76 mm) by length indicated.

G. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.0538 inch (1.37 mm) and minimum 1/2-inch- (12.7-mm-) wide flanges.
1. Depth: 2-1/2 inches (64 mm).
2. Form to required radius at curved ceilings
3. At ceilings and soffits to receive tile. Brace as required to reduce upward deflection.

H. Furring Channels (Furring Members):
1. Cold-Rolled Channels: 0.0538-inch (1.37-mm) bare-steel thickness, with minimum 1/2-inch- (12.7-mm-) wide flanges, 3/4 inch (19.1 mm) deep.
2. Steel Studs: ASTM C645.
a. Minimum Base-Metal Thickness: 0.0179 inch (0.45 mm).
b. Depth: As indicated on Drawings.
3. Hat-Shaped, Rigid Furring Channels: ASTM C645, 7/8 inch (22.2 mm) deep.
a. Minimum Base Metal Thickness: As indicated on Drawings.
4. Resilient Furring Channels: 1/2-inch- (12.7-mm-) deep members designed to reduce sound transmission.

I. Grid Suspension System for Ceilings: ASTM C645, direct-hung system composed of main beams and cross-furring members that interlock.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Armstrong World Industries, Inc.; Drywall Grid Systems.
b. Chicago Metallic Corporation; Drywall Furring System.
c. USG Corporation; Drywall Suspension System.

2.11 STEEL FRAMING FOR FRAMED ASSEMBLIES

A. Steel Components: Comply with ASTM C645 requirements for metal, unless otherwise indicated.
1. Coatings:
a. General: Provide minimum G40 coating or EQ equivalent on all components except as otherwise indicated.
b. Provide minimum G90 coating or EQ equivalent on all components within or adjacent to the following areas: Indoor Pool Room and Locker Room Wet Areas, including Showers Areas, Steam Rooms and Whirlpool Suites as indicated on Drawings.

B. Slip-Type Head Joints: Where indicated, provide one of the following:
1. Single Long-Leg Runner System: ASTM C645 top runner with 2-inch- (50.8-mm-) deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging located within 12 inches (305 mm) of the top of studs to provide lateral bracing.

2. Double-Runner System: ASTM C645 top runners, inside runner with 2-inch- (50.8-mm-) deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.
3. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.

C. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.

D. Hat-Shaped, Rigid Furring Channels: ASTM C645.
1. Minimum Base Metal Thickness: 0.0179 inch (0.45 mm).
2. Depth: 7/8 inch (22.2 mm).

E. Resilient Furring Channels: 1/2-inch- (12.7-mm-) deep, steel sheet members designed to reduce sound transmission.

F. Cold-Rolled Furring Channels: 0.0538-inch (1.37-mm) bare-steel thickness, with minimum 1/2-inch- (12.7-mm-) wide flanges.
1. Depth: 3/4 inch (19.1 mm).
2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum bare-steel thickness of 0.0312 inch (0.79 mm).
3. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.0625-inch- (1.59-mm-) diameter wire, or double strand of 0.0475-inch- (1.21-mm-) diameter wire.

G. Z-Shaped Furring: With slotted or non-slotted web, face flange of 1-1/4 inches (31.8 mm), wall attachment flange of 7/8 inch (22.2 mm), minimum bare-metal thickness of 0.0179 inch (0.45 mm), and depth required to fit insulation thickness indicated.

H. Stud Isolation Strips:
1. Provide Isolation strips and washers as part of engineered isolation wall system indicated on Drawings.
a. Manufacturer/Products: Subject to compliance with requirements, provide one of the following:
1) Kinetics Noise Control, “Wallmat Stud Isolation Strip”; www.kineticsnoise.com
2) CMS Danskin Acoustics, “Regupol Strips”; www.cmsdanskin.com.uk
3) Or approved equal.

I. Floor Ties:
1. Provide floor ties at half-walls and as recommended by manufacturers to prevent wall deflection.
a. ASTM A1003/A1003M Structural Grade 50, Type H, ST50H, with 50 ksi min yield strength and 65 ksi minimum tensile strength with ASTM A653/A653M galvanized coating.
1) The Steel Network: Stiffclip CL.
2) Or approved equal.

2.12 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.
1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. Isolation Strip at Exterior Walls: Provide one of the following:
1. Asphalt-Saturated Organic Felt: ASTM D226/D226M, Type I (No. 15 asphalt felt), non-perforated.
2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch (3.2 mm) thick, in width to suit steel stud size.

2.13 PARTITION GAP CLOSURE ACCESSORIES

A. Adjustable, insulated metal closures for installation between gypsum board walls and curtain wall or window mullions.

B. Where indicated on drawings, install the following where indicated:
   1. Mullion Mate: Series 60
   2. Or approved equal.

C. Color: To be selected by Architect.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames and framing, for compliance with requirements and other conditions affecting performance.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C840 A.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
   1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
   2. Fit gypsum panels around ducts, pipes, and conduits.
   3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations, and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

I. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
   1. Install sound attenuation blankets before installing gypsum panels, unless blankets are readily installed after panels have been installed on one side.

3.03 APPLYING INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:
   1. Type X: Vertical surfaces, unless otherwise indicated.
   2. Type C: Where required for specific fire-resistance-rated assembly indicated.

3. Flexible Type: Apply in double layer at curved assemblies.
4. High-Impact Type: As indicated on Drawings.
5. Moisture and Mold-Resistant Type: As indicated on Drawings.

B. Rated Assemblies:
1. Install all rated assemblies in accordance with rated assemblies indicated on Drawings.

C. Single-Layer Application:
1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing, unless otherwise indicated.
2. On partitions/walls, apply gypsum panels vertically (parallel to framing), unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
b. At stairwells and other high walls, install panels horizontally, unless otherwise indicated or required by fire-resistance-rated assembly.
3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

D. Double Layer Application:
1. Place first layer parallel to framing or furring members, with ends and edges occurring over firm bearing. Place second layer perpendicular to framing or furring members. Offset joints of second layer from joints of first layer.

E. Curved Surfaces:
1. Install panels horizontally (perpendicular to supports) and unbroken, to extent possible, across curved surface plus 12-inch- (300-mm-) long straight sections at ends of curves and tangent to them.
2. For double-layer construction, fasten base layer to studs with screws 16 inches (400 mm) o.c. Center gypsum board face layer over joints in base layer, and fasten to studs with screws spaced 12 inches (300 mm) o.c.

3.04 APPLYING EXTERIOR GYPSUM SHEATHING

A. Apply panels perpendicular to supports, with end joints staggered and located over supports.
1. Install with 1/4-inch (6.4-mm) open space where panels abut other construction or structural penetrations.
2. Fasten with corrosion-resistant screws.

3.05 APPLYING TILE BACKING PANELS

A. Water-Resistant Gypsum Backing Board: Install at locations indicated on drawings. Install with 1/4-inch (6.4-mm) gap where panels abut other construction or penetrations.

B. Glass-Mat, Water-Resistant Backing Panel: Comply with manufacturer's written installation instructions and install where indicated on drawings. Install with 1/4-inch (6.4-mm) gap where panels abut other construction or penetrations.

C. Cementitious Backer Units: Per ANSI A108.11, Comply with manufacturer's written installation instructions and install where indicated on drawings.

D. Areas Not Subject to Wetting: Install regular-type gypsum wallboard panels to produce a flat surface except where indicated to receive water-resistant panels.

E. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.06 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints at locations indicated on Drawings.

C. Interior Trim: Install in the following locations:
   1. Cornerbead: Use at outside corners, unless otherwise indicated.
   2. Bullnose Bead: Use where indicated.
   3. LC-Bead: Use at exposed panel edges.
   4. L-Bead: Use where indicated.
   5. U-Bead: Use at exposed panel edges.
   6. Curved-Edge Cornerbead: Use at curved openings.

D. Exterior Trim: Install in the following locations:
   1. Cornerbead: Use at outside corners.
   2. LC-Bead: Use at exposed panel edges.

3.07 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints and damaged surface areas.

C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C840:
   1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
   2. Level 2: Panels that are substrate for tile.
   3. Level 3: Panels that are exposed to view in Back of House areas.
   4. Level 4: At panel surfaces that will be exposed to view in member facing areas, unless otherwise indicated.
      a. Primer and its application to surfaces are specified in other Division 9 Sections.
   5. Level 5: Where Indicated.
      a. Primer and its application to surfaces are specified in other Division 9 Sections.

E. Glass-Mat Gypsum Sheathing Board: Finish according to manufacturer's written instructions for use as exposed soffit board.

F. Glass-Mat, Water-Resistant Backing Panels: Finish according to manufacturer's written instructions.

G. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.08 FRAMING INSTALLATION, GENERAL

A. Installation Standard: ASTM C754, except comply with framing sizes and spacing indicated.
   1. Gypsum Board Assemblies: Also comply with requirements in ASTM C840 that apply to framing installation.

B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

C. Install bracing at terminations in assemblies.

D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.09 INSTALLING SUSPENSION SYSTEMS

A. Install suspension system components in sizes and spacing indicated on Drawings, but not less than those required by referenced installation standards for assembly types and other assembly components indicated.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure as follows:
   1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.

a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, counter-splaying, or other equally effective means.

2. Where width of ducts and other construction within ceiling plenum produces hanger spacing that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
   a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
5. Do not attach hangers to steel roof deck.
6. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
7. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

E. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

F. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

3.10 INSTALLING FRAMED ASSEMBLIES

A. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

B. Install studs so flanges within framing system point in same direction.
   1. Space studs as follows:
      a. Single-Layer Application: 24 inches (610 mm) o.c., unless otherwise indicated.
      b. Tile backing panels: 16 inches (406 mm) o.c., unless otherwise indicated.

C. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.
   1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
   2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
      a. Install two studs at each jamb, unless otherwise indicated.
      b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch (12.7-mm) clearance from jamb stud to allow for installation of control joint in finished assembly.
      c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
   3. Other Framed Openings: Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
   4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
      a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
   5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.

6. Curved Partitions:
    a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
    b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of not less than 2 studs at ends of arcs, place studs 6 inches (150 mm) o.c.

D. Direct Furring:
    1. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.

E. Z-Furring Members:
    1. Erect insulation (specified in 07 21 00 Thermal Insulation) vertically and hold in place with Z-furring members spaced 24 inches (610 mm) o.c.
    2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (600 mm) o.c.
    3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches (300 mm) from corner and cut insulation to fit.

3.11 PROTECTION

A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

B. Remove and replace panels that are wet, moisture damaged, or mold damaged.
    1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
    2. Indications that panels are mold damaged include fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

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SECTION 09 30 00
TILING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Tile:
      a. Porcelain/Ceramic tile.
      b. Glass tile.
      c. Stone tile.
      d. Pool tile, Pool Accent tile, Nosing and Coping.
      e. Stone Base.
   2. Interior Tile Application:
      a. Mortar floor sloping.
      b. Crack isolation membrane.
      c. Setting Materials.
      d. Grout Materials.
      e. Miscellaneous Materials.
         1) Trowelable Underlayments.
         2) Metal edge strips.
         3) Tile Cleaner.
         4) Grout Sealer.
         5) Stone tile Sealer/enhancer.
      f. Waterproof System.
         1) Waterproof Membrane.
            (a) Membrane Components.
            (b) Accessories.
   3. Exterior Tile Application:
      a. Setting Materials.
      b. Grout Materials.

1.02 DEFINITIONS

A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.

B. Module Size: Actual tile size plus joint width indicated.

C. Face Size: Actual tile size, excluding spacer lugs.

D. Wet Areas: Any area where waterproofing is installed. See key plan on Drawings.

1.03 RELATED SECTIONS

A. Section 01 31 00 - Project Management and Coordination.

B. Section 01 33 00 - Submittal Procedures.

C. Section 01 40 00 - Quality Requirements.

D. Section 01 60 00 - Product Requirements.

E. Section 03 30 00 - Cast-in-Place Concrete.

F. Section 04 20 00 - Unit Masonry.

G. Section 06 10 00 - Rough Carpentry.

H. Section 07 24 19 – Water-Drainage EIFS

I. Section 07 92 00 - Joint Sealants.

J. Section 09 21 16 - Gypsum Board Assemblies.

K. Section 09 30 01 - Tiling Schedules.

L. Section 13 11 15 - Swimming Pool Finishes.

M. Section 22 13 19 - Sanitary Waste Piping Specialties.

1.04 REFERENCE STANDARDS

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; Current Edition.

B. ADAAG - Americans With Disabilities Act Accessibility Guidelines; 2010.

C. ANSI A108.01 - General Requirements: Subsurfaces and Preparations by Other Trades; 2021a.

D. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar; 2023.

E. ANSI A108.02 - General Requirements: Materials, Environmental, and Workmanship; 2019.

F. ANSI A108.13 - American National Standard for Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone; 2005 (Reaffirmed 2021).

G. ANSI A118.3 - American National Standard Specifications for Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy and Water Cleanable Tile-Setting Epoxy Adhesive; 2021.

H. ANSI A118.4 - American National Standard Specifications for Modified Dry-Set Cement Mortar; 2023.

I. ANSI A118.7 - American National Standard Specifications for High Performance Cement Grouts for Tile Installation; 2019.

J. ANSI A118.10 - American National Standard Specifications for Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation; 2023.

K. ANSI A118.11 - American National Standard Specifications for EGP (Exterior Glue Plywood) Modified Dry-Set Mortar; 2017 (Reaffirmed 2022).

L. ANSI A118.12 - American National Standard Specifications for Crack Isolation Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation; 2014 (Reaffirmed 2019).

M. ANSI A118.15 - American National Standard Specifications for Improved Modified Dry-Set Cement Mortar; 2023.

N. ANSI A137.1 - American National Standard Specifications for Ceramic Tile; 2022.

O. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished; 2018.

P. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2019a, with Editorial Revision.

Q. ASTM C482 - Standard Test Method for Bond Strength of Ceramic Tile to Portland Cement Paste; 2020.

R. ASTM C627 - Standard Test Method for Evaluating Ceramic Floor Tile Installation Systems Using the Robinson-Type Floor Tester; 2018.

S. ASTM C794 - Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants; 2018 (Reapproved 2022).

T. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.

U. ASTM C1028 - Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method; 2007.

V. ASTM C1708/C1708M - Standard Test Methods for Self-Leveling Mortars Containing Hydraulic Cements; 2023.

W. ASTM D5957 - Standard Guide for Flood Testing Horizontal Waterproofing Installations; Current Edition.

X. ASTM D7877 - Standard Guide for Electronic Methods for Detecting and Locating Leaks in Waterproof Membranes; 2024.

Y. IAPMO (UPC) - Uniform Plumbing Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

Z. ISO 13007-2 - Ceramic Tiles - Grouts and Adhesives - Part 2: Test Methods for Adhesives; 2013.

AA. ISO/IEC 17025 - General Requirements for the Competence of Testing and Calibration Laboratories; 2017.

BB. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2024.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the work of this section with minimum five years experience.

B. Source Limitations for Setting Materials and Accessories: Obtain product of a uniform quality for each application condition from a single manufacturer.

C. Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ASTM C1028 and:
   1. Level Surfaces: Accessible Routes as defined by ADAAG, Minimum 0.5 static coefficient of friction.
   2. Step Treads: Accessible Routes as defined by ADAAG, Minimum 0.5 static coefficient of friction.
   3. Ramp Surfaces: Accessible Ramps as defined by ADAAG, Minimum 0.8 static coefficient of friction.

D. Preinstallation Conference: Conduct conference at the Project site.
   1. Convene one week prior to commencing work of this section.
   2. Require attendance of installation material manufacturer, tile supplier, tile installer and installers of related work. Review installation procedures and coordination required with related work.
   3. Meeting agenda includes but is not limited to:
      a. Surface preparation.
      b. Tile and installation material compatibility.
      c. Edge protection, transition and pre-fabricated movement joint profiles.
      d. Waterproofing techniques.
      e. Crack isolation techniques.
      f. Flood testing techniques.

1.06 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Verification:
   1. Full-size units of each type and composition of tile and for each color and finish required. For ceramic mosaic tile in color blend patterns, provide full sheets of each color blend.

C. Quantity Take-offs:
   1. Submit material quantity take offs for all material types.

D. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.
   3. See Sections 01 33 00 and 01 60 00.

E. Mock-Up:
   1. Tile: Provide a mock-up for evaluation of surface preparation techniques and application quality of work.
      a. Finish areas designated by Architect.
      b. Do not proceed with remaining work until mock up is approved by Architect.
      c. Refinish mock-up area as required to produce acceptable work.
      d. Mock up may be used as part of finished work.
   2. Waterproofing Provide mock-up of each waterproofing system.

a. Steam Room: (Sheet applied)
    1) Mock up to consist of 1 shower stall, including drain, pipe penetration, wall to wall and wall to floor transitions.
    2) Show materials 'cut away' such that each layer of the assembly are exposed to view.
    3) Include all applicable materials of the assembly.
b. General application: (Fluid applied)
    1) Mock up to consist of a 4' x 4' x 4' minimum area. Include a bottom corner, with transitions between wall to wall and wall to floor, and bench.
    2) Show materials 'cut away' such that each layer of the assembly are exposed to view.
    3) Include all applicable materials of the assembly.
c. Do not proceed with work until mock up is approved by Architect.
d. Refinish mock-up area as required to produce acceptable work.
e. Mock-up may be incorporated into finished work.
f. Tile included as part of a system mock-up may serve as the required tile mock-up.

3. Procurement:
    a. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
    b. Submit inventory to Owner within 5 days of delivery of materials.
    c. See Sections 01 33 00 and 01 60 00.
4. Executed Warranty.
    a. See below.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

C. Store aggregates where grading and other required characteristics can be maintained, and contamination can be avoided.

D. Store liquid materials in unopened containers and protected from freezing.

E. Protect waterproofing, grout and mortar materials from exposure to moisture. Do not deliver until after wet work is complete and dry.

F. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.08 PROJECT CONDITIONS

A. Environmental Limitations: Do not install tile or waterproofing materials until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

1.09 WARRANTY

A. Provide manufacturer's standard warranty for each tile.

B. The Contractor warrants the work of this Section to be in accordance with the Contract Documents and free from faults and defects in materials and workmanship for a period as determined by local or project requirements. The manufacturer of adhesives, mortars, grouts and other installation materials shall provide a written twenty five (25) year warranty, which covers materials and labor - reference LATICRETE Warranty Data Sheet 025.0 for complete details and requirements. Single source manufacture.

PART 2 PRODUCTS

2.01 PRODUCTS, GENERAL

A. Tile:

1. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
2. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA (HB) installation methods specified in tile installation schedules, and other requirements specified.
3. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.
4. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.
    a. Where tile is indicated for installation in swimming pools on exteriors or in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.
5. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating with continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.
6. At Pool Shower Wall and all outside corners / drains where tile cut edge is exposed. To be wet saw cut mechanically sanded, polished and profiled as not to be sharp. Ease edge smooth to touch.

2.02 PORCELAIN/CERAMIC TILE

A. See attached Schedule.

2.03 GLASS TILE

A. See attached Schedule.

2.04 STONE TILE

A. See attached Schedule.

2.05 STONE BASE

A. See attached Schedule.

2.06 WATERPROOF SYSTEMS

A. Fluid Applied Membrane System:
1. General Application: Waterproofing and Crack Isolation Membrane to be thin, cold applied, single component liquid and load bearing and UL GREENGUARD Gold certified. Reinforcing fabric to be non-woven rot-proof specifically intended for waterproofing membrane. Waterproofing Membrane to be non-toxic, non-flammable, and non-hazardous during storage, mixing, application and when cured with ANSI A118.10 and ANSI A118.12; ASTM C627.
    a. LATICRETE International, Inc.; HYDRO BAN®.
2. Steam application: Waterproofing Sheet Membrane to be thin, durable polyethylene core with a fused non-woven polypropylene exterior surface, IAPMO (UPC) approved as shower pan liner, and allow for use of either polymer modified or un-modified tile mortars, depending upon substrate and type of tile used. ANSI 118.10, ASTM C627.
    a. LATICRETE International, Inc.; HYDRO BAN Sheet Membrane®.
    b. Accessories: Pipe & Corner reinforcement; LATICRETE International, Inc.; HYDRO BAN Sheet Membrane® Corners & Pipe Collars as recommended by manufacturer.
3. Tile Setting Materials: Latex-Portland Cement Mortar: (Inside Pool Shell (non-stainless steel)
    a. LATICRETE International, Inc. 254 Platinum®, Exceeds ANSI ANSI A118.4, ANSI A118.11, & ANSI A118.15.
    b. LATICRETE International, Inc. 254R Platinum Rapid (Rapid Set Mortar when specified) ANSI A118.11.
4. Epoxy Adhesive:
    a. LATICRETE International, Inc. LATAPOXY® 300 Adhesive (Epoxy Adhesive, Suitable steel substrates when specified) ANSI A118.3

5. See below for grout materials.

2.07 CRACK ISOLATION MEMBRANE

A. General: Manufacturer's standard product that complies with ANSI A118.12 for standard performance and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

B. Membrane strips must cover three (3) times the width of the floor tile used, with a minimum width of 36 inches.
   1. Crack Isolation and Waterproof Membrane: Waterproofing and anti-fracture/crack suppression membrane.
      a. LATICRETE International, Inc; HYDRO BAN®.

2.08 MORTAR BED MATERIALS

A. Pre-Blended, Polymer-Modified, Cement-Based, Sloping Mortar.
   1. LATICRETE International, Inc.; 3701 Fortified Mortar or 3701 LITE Fortified Mortar.

B. Quick Setting, Polymer Modified, Fiber-Reinforced, Cementitious Rendering, Patching and Leveling Mortar.
   1. LATICRETE International, Inc.; 3701 Lite Mortar R.

2.09 SELF-LEVELING UNDERLAYMENT

A. High quality, fiber reinforced, cement-based, self leveling underlayment for use in leveling suitable interior substrates. For large format tile as identified by TCNA, or as specified. 5300 psi (36.5 MPa) (ASTM C1708/C1708M 28 days)
   1. LATICRETE International, Inc; NXT Level Plus with NXT Primer.

2.10 SETTING MATERIALS

A. Improved Modified, Dry-Set Portland Cement Mortar (Thin-Set,): ANSI A118.15.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following: (Except in connection with the Waterproof systems specified herein.)
      a. LATICRETE International, Inc.; MULTIMAX LITE®

2.11 GROUT MATERIALS

A. Premium Epoxy Mortar and Grout: (Wet Areas: Floors, Walls, Ceilings) For grout joints from 1/16 inch to 1/2" ANSI A118.3, ISO 13007-2 R2 and RG, with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D.
   1. Product: Subject to compliance with requirements, provide the following:
      a. LATICRETE International, Inc; SPECTRALOCK PRO PREMIUM®

B. High Performance, Polymer-Modified Tile Grout: (Non-Wet Area Walls) ANSI A118.7.
   1. Manufacturers: Subject to compliance with requirements, provide products of the following:
      a. LATICRETE International, Inc.; PERMACOLOR ®

C. Flexible Sealant: Professional-grade, 100%-silicone sealant specifically formulated for heavy traffic expansion and movement joints, horizontal and vertical complying with ASTM standards; joint movement (ASTM C920), adhesion (ASTM C794) and passes weatherability (Accelerated Weathering Tester QUV), Shore A hardness (27).
   1. Product: Subject to compliance with requirements, provide the following:
      a. LATICRETE International, Inc.; LATASIL™

2.12 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
   1. Product: Subject to compliance with requirements, provide the following:
      a. LATICRETE International, Inc., NXT Skim Lite.
      b. LATICRETE International, Inc., NXT Patch.

B. Metal Edge Strips: Angle or L-shape, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications.
   1. Acceptable Manufacturers:
      a. Schluter.
      b. Laticrete.
      c. Or approved equal.

C. Custom Transitions:
   1. Sloped Mortar:
      a. Description: Mortar slope to achieve flush transition between tile and another floor material.
      b. Material and Finish: See drawings.
      c. Height: As required.
      d. Location: See drawings.

D. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.
   1. Product: Subject to compliance with requirements, provide the following:
      a. LATICRETE International, Inc.; STONETECH® Stone & Tile Cleaner (Concentrate) Daily.
      b. LATICRETE International, Inc.; STONETECH® Klenzall Cleaner (Concentrate) Deep Clean.

E. Grout Sealer: Premium, water based penetrating sealer, for sealing grout joints and that does not change color or appearance of grout.
   1. Product: Subject to compliance with requirements, provide the following:
      a. LATICRETE International, Inc; STONETECH® BulletProof.

F. Flexible Sealant: Professional-grade, 100%-silicone sealant specifically formulated for heavy traffic expansion and movement joints, horizontal and vertical complying with ASTM standards; shore A hardness (27), joint movement (ASTM C920), adhesion (ASTM C794) and passes weatherability (Accelerated Weathering Tester QUV).
   1. Product: Subject to compliance with requirements, provide the following:
      a. LATICRETE International, Inc., LATASIL.

G. Stone Tile Sealer/Enhancer: Solvent based, penetrating sealer formulated to prevent oil and water based staining to stone while not changing the surface's appearance or finish. To be used on indicated Stone Tile only, see schedule.
   1. Product: Subject to compliance with requirements, provide the following:
      a. Laticrete, Stonetech Bulletproof Sealer.

2.13 EXTERIOR APPLICATION

A. General: Where exterior tile installation is indicated, provide products recommended by their manufacturers for the application.

B. Exterior Wall and Soffit application:
   1. Backing material: As indicated on drawings and approved for tile application by its manufacturer and Laticrete.
   2. Polymer-Modified Mortar.
      a. One-component, polymer fiber reinforced veneer mortar, to meet or exceed ASTM C270 compressive strength requirements and IBC ASTM C482 Shear bond strength requirements, and ANSI A118.4 for adhered stone and tile.
      b. For use to adhere exterior thin masonry units or ceramic tile as shown on drawings.
         1) Exposed joints shall use Cementitious Mortar above.
      c. Manufacturers and Products:
         1) Basis of Design: Laticrete MVIS Veneer Mortar. Verify mortar is compatible with EIFS substrate prior to ordering.
         2) Or approved equal.
      d. Water: Potable.
   3. High Performance, Polymer-Modified Tile Grout: ANSI A118.7.

a. Manufacturers: Subject to compliance with requirements, provide products of the following:
1) LATICRETE International, Inc.; PERMACOLOR ®

4. High Performance, STPE Sealant: ASTM C1382 for use with EIFS.
a. Manufacturers: StoSeal STPE Sealant, #81802, with primer.
1) Sealant shall conform to physical and mechanical property requirements of ASTM C920 with minimum elongation and contraction capability of +100% and -50%
2) Location: Corners and around fixtures at EIFS substrate.

C. Exterior Floor application:
1. Quick Setting, Polymer Modified, Fiber-Reinforced, Cementitious Rendering, Patching and Leveling Mortar.
a. LATICRETE International, Inc.; 3701 Lite Mortar R.
2. High Performance, Polymer-Modified Tile Grout: ANSI A118.7.
a. Manufacturers: Subject to compliance with requirements, provide products of the following:
1) LATICRETE International, Inc.; PERMACOLOR ®

D. Expansion Joint:
1. Stainless Steel profile as detailed.
2. Install as shown on drawings and recommended by tile Manufacturer.

PART 3 EXECUTION

3.01 SYSTEMS

A. Provide Waterproof system components only where indicated on Drawings.

B. At Waterproof systems, do not begin tiling work until flood test(s) have been performed.

3.02 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
1. Verify that substrates for setting tile are firm, dry, clean, free of coatings that are incompatible with tile-setting materials including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
2. Verify that concrete substrates for tile floors installed with bonded mortar bed or thin-set mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.
a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.03 PREPARATION

A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thin-set mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1a and is sloped 1/4 inch per foot (1:50) toward drains. All waterproofing to be sloped to drains.

C. All recessed areas sloped / apply waterproofing. Bead elastomeric caulk at all drains.

D. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and

match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.04 WATERPROOFING INSTALLATION

A. Install waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness and bonded securely to substrate.

B. Do not install tile or setting materials over waterproofing until waterproofing has cured and been tested to determine that it is watertight.

C. Testing:
   1. Perform ELD (Electronic Leak Detection) test of vertically applied waterproof membrane to ensure that it attains specified resistance to moisture penetration.
      a. Testing to be performed according to the requirements of ASTM D7877 by ISO/IEC 17025 certified personnel.
      b. Patch or replace failed areas as recommended by manufacturer.
   2. Perform Flood testing of all waterproofing systems.
      a. Perform test according to ASTM D5957.
      b. Examine all adjacent areas and areas below for signs of water leakage.
      c. If leakage is detected, demolish and replace waterproof membrane.
      d. Do not proceed with work until flood tests are passed.

3.05 CRACK ISOLATION MEMBRANE INSTALLATION

A. Install crack isolation membrane to comply with ASTM A108.17 and manufacturer's written instructions to produce membrane of uniform thickness and bonded securely to substrate.

B. Do not install tile or setting materials over crack isolation membrane until membrane has cured.

3.06 TILE INSTALLATION

A. Comply with TCNA's "Handbook for Ceramic Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 Series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

C. Tile setting:
   1. All tile installed over a waterproof system to be 90% min bonded to substrate. Do not allow voids behind tiles in wet areas.
   2. Slope setting materials in waterproofed areas to drains.
      a. Cut large format tile if necessary to slope to drain.
      b. Do not install a drain within a large format tile without proper sloping.

D. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

E. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
   1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
   2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
   3. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.

F. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

G. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
   1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
   2. Provide 3/16; expansion joints in Pool Deck: locate expansion joints at perimeter of Lap and Leisure pools; aligned with saw/control joints in concrete throughout the entire pool deck. See movement joint layout on Floor Finish Drawings.
   3. Install expansion and control joints in accordance with TCNA method EJ171.

H. Metal Edge Strips: Install where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile.
   1. Fill metal edge strips and coves in wet areas with grout.

I. Mortar and Grout Curing:
   1. Allow Mortar and Grout to cure for the minimum duration recommended by manufacturer before proceeding.
   2. Ensure temperature and humidity are within required range during this period.

J. Grout Sealer: Apply grout sealer to cementitious grout joints according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

K. Exterior Application:
   1. Wet bonding surfaces of tile thoroughly prior to installation in dry climates.
   2. See Section 04 20 00 for more information.

3.07 STONE TILE SEALER APPLICATION

A. Apply only to scheduled materials, see schedule.

B. Apply according to Manufacturer's instructions.

C. Do not apply multiple coats.

D. Wipe away excess sealer before it dries.

E. Protect surface during drying period.
   1. See manufacturer's written instructions.

3.08 CLEANING AND PROTECTING

A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
   1. Remove grout residue from tile as soon as possible.
   2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
   3. Remove temporary protective coating by method recommended by coating manufacturer and that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent drain clogging.

B. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.

C. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

D. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

END OF SECTION

SECTION 09 30 01
TILING - SCHEDULES

GROUT

1.01 LATICRETE SPECTRALOCK PRO PREMIUM

A. Color: as specified per tile type.

B. Location:
   1. Vanity area - Floors.
   2. Showers - Floors, walls, ceilings.
   3. Whirlpool Suites - Floors, walls.
   4. Steam rooms - Floors, walls, ceilings.
   5. Sauna - Floors.
   6. Family Locker - Floors.
   7. Family Changing Rooms - Floors, walls, ceilings.
   8. Pool Restrooms - Floors, walls, ceilings.
   9. Pool - Grip at edge of pool and all tiled surfaces interior of vessel - waterline, steps, nosing, benches, lane lines and markers, etc.

1.02 LATICRETE PERMACOLOR

A. Color: As specified per tile type.

B. Location: All other locations not listed above for Spectralock; general tile walls, floors, ceilings.

PORCELAIN/CERAMIC TILE

2.01 TL-9A

A. Distributor: Kate Lo

B. Manufacturer: Olympia Tile

C. Series: Boutique Selections

D. Color: Bianco Wood

E. Size: 12" x 24"

F. Code: GM.B.WOOD.1224.HN

G. Joint Width: 1/8”

H. Grout: Laticrete CLR #93 Fossil

I. Location: Wall – See drawings

J. Contact: Jennifer Bohlinger; 763-232-6531, jennifer@katelotile.com

K. URL: https://www.katelotile.com/find-tile/bianco-wood-limestone/

2.02 TL-9M

A. Distributor: Kate Lo

B. Manufacturer: Olympia Tile

C. Series: Boutique Selections

D. Color: Bianco Wood

E. Size: 11.8” x 11.8” Mosaic

F. Code: GM.BIA.WD.ECH.IRR

G. Grout: Laticrete CLR #93 Fossil

H. Location: Café Backline, Coffee Bar, LT Work – Break Room Accent Wall Tile

I. Contact: Jennifer Bohlinger; 763-232-6531, jennifer@katelotile.com

J. URL: http://www.olympiatile.com/product/series/92/boutique_selections#3232-echelon_pattern_mosaics

2.03 TL-15A

A. Distributor: Kate-Lo
B. Manufacturer: Olympia Tile
C. Series: Rock
D. Color: Brown
E. Finish: Matte, Natural
F. Size: 12" x 24"
G. Code: OL.RK.BWN.1224.N
H. Joint Width: 1/8”
I. Grout: Laticrete CLR #35 Mocha
J. Location: Walls Exterior Bistro
K. Installation: Straight Stacked
L. Contact: Jennifer Bohlinger, (763) 232-6531, jennifer@katelotile.com

2.04 TL-21S

A. Distributer: MSI
B. Manufacturer: MSI
C. Series: Palmetto Smoke Product
D. Style: Wood
E. Color: Smoke
F. Finish: Matte
G. Size: 6" x 36"
H. Product Code: NPALSMO6X36
I. Joint Width: 1/8"
J. Grout: Laticrete CLR #35 Mocha
K. Location: Rooftop Deck
L. Installation: By Designer
M. Contact: Eric Lovestrand, Eric.L@msisurfaces.com, 952-486-6600 (P) or 763-203-5065 (C)
N. Lead Time: 5-10 days to process & ship
O. URL: https://www.msisurfaces.com/wood-look-tile/porcelain/palmetto/smoke/

2.05 TL-22A

A. Manufacturer: Daltile
B. Series: Society
C. Color: Civic Sand S046
D. Finish: Unpolished
E. Size: 12" x 24"
F. Joint Width: 1/8"
G. Grout: Laticrete CLR #17 Marble Beige
H. Location: Cafe/Bar and Walls-Yoga
I. Contact: E-mail: Lifetime.fitness@daltile.com, Phone: 877.556.5728

J. URL: https://www.daltile.com/product/Society?color=Civic-Sand&shape=Rectangle

2.06 TL-24XP

A. Manufacturer: Crossville Inc.
B. Distributer: Virginia Tile
C. Series: I Naturali
D. Color: Stocking Calacatta Oro Venato Polished
E. Size: 1M x 3M
F. Thickness: 5.6mm
G. Code: L0318.1M3M
H. Joint Width: 1/16”
I. Grout:
   1. Laticrete CLR #95 Mink
J. Location: Styling Focal Wall, Focal Walls; see drawings.
K. URL: https://www.crossvilleinc.com/Products/I-Naturali/Calacatta-Oro-Venato-Polished

2.07 TL-26A

A. Distributor: Virginia Tile
B. Manufacturer: Caesar Ceramics, USA
C. Series: Stoneways
D. Color: Flight
E. Finish: Matte, Rectified
F. Size: 12” x 24”
G. Code: CSUSTFL1224R
H. Joint Width: 1/8”, if installed in offset pattern: 3/16” per manufacturer
I. Grout: Laticrete CLR #17 Marble Beige or Laticrete CLR #94 Walnut, see drawings
J. Installation: See drawings
K. Location: Cap Ex
L. Contact: Cristin Hennessy, 612-801-6758, Cristin.Hennessy@VirginiaTile.com
M. URL: Stoneways Flight 12x24 Field Tile Matte Rectified - Virginia Tile Company

2.08 TL-28B

A. Distributer: Anatolia
B. Manufacturer: Virginia Tile
C. Series: Life Time Fitness Calacatta
D. Color: Anatolia La Marca Paonazzo
E. Finish: Unpolished
F. Size: 12" x 24"
G. Joint Width: 1/8”
H. Grout: To match Bostic Mobe Pearl Grout
I. Location: Focal Floor or Wall.
J. Installation: Stacked
K. Contact: Cristin Hennessy, 612-801-6758, Cristin.Hennessy@VirginiaTile.com
L. URL: https://www.anatolia.com/collections/la-marca/calacatta-paonazzo

2.09 TL-30Z

A. Manufacturer: Wow Tile
B. Distributer: Virginia Tile
C. Collection: Odyssey
D. Color: Green
E. Finish: Matte
F. Product Number: VTLOYGN216M
G. Size: 2" x 16"
H. Joint Width: 1/8”
I. Grout: Laticrete CLR #60 Dusty Grey
J. Location: Walls
K. Installation: Stacked
L. Note: Flat Version
M. Contact: Cristin Hennessy, 612-801-6758, Cristin.Hennessy@VirginiaTile.com
N. Lead Time: Allow 8-10 weeks
O. URL: https://www.wowdesigneu.com/collection/faces/

2.10 TL-30ZS

A. Manufacturer: Wow Tile
B. Distributer: Virginia Tile
C. Collection: Odyssey
D. Series: Gully
E. Color: Green
F. Finish: Matte
G. Product Number: VTLOYGNGULLYM
H. Size: 2" x 16"
I. Joint Width: 1/8”
J. Grout: Laticrete CLR #60 Dusty Grey
K. Location: Walls
L. Installation: Stacked
M. Note: Concave Version.
N. Contact: Cristin Hennessy, 612-801-6758, Cristin.Hennessy@VirginiaTile.com
O. Lead Time: Allow 8-10 weeks
P. URL: https://www.wowdesigneu.com/collection/faces/

2.11 TL-31S

A. Manufacturer: Daltile
B. Distributer: Daltile
C. Series: Sleigh Creek
D. Color: Carriage SK32
E. Finish: Matte

F. Size: 6” x 36”
G. Joint Width: 1/16”
H. Grout: Laticrete CLR #35 Mocha
I. Installation: Third Offset
J. Location: Cafe Floors, Base at Member side of Cafe Service Line
K. Contact: E-mail: Lifetime.fitness@daltile.com, Phone: 877.556.5728
L. URL: https://www.daltile.com/products/Wood-Look/Sleigh-Creek/Carriage

2.12 TL-32BB

A. Vendor: Virginia Tile
B. Manufacturer: VITL
C. Series: Cityscape
D. Size: 1.5" x 4.6"
E. Color: Light Blue
F. Finish: Gloss
G. Sku: VTLCOLB25G
H. Grout: LATICRETE CLR #09 FROSTY
I. Installation: Stacked
J. Location: Spa Waterline
K. Contact: Cristin Hennessy 612-801-6758
L. URL: https://lunadabaytile.com/collections/origami-mosaic/products/vesper?variant=41453365526681

2.13 TL-51B

A. Distributer: Virginia Tile
B. Manufacturer: VITL
C. Series: Camilla
D. Color: Beige
E. Finish: Matte
F. Size: 24" x 24", Rectified
G. Code: VTLCABE2424R
H. Joint Width: 1/8”
I. Grout: Laticrete CLR #17 Marble Beige
J. Installation: Straight Stacked
K. Location: Ceiling- Showers
L. Contact: Cristin Hennessy Cristin.Hennessy@VirginiaTile.com
M. URL: https://url.usb.m.mimecastprotect.com/s/xpr4C0AjgrHWXLOYIwf2c9uVqx?domain=virginiatile.com/

2.14 TL-51BP

A. Distributer: Virginia Tile
B. Manufacturer: VITL
C. Series: Camilla

D. Color: Beige
E. Finish: Polished
F. Size: 24" x 24", Rectified
G. Code: VTLCABE2424P
H.
I. Joint Width: 1/8”
J. Grout: Laticrete CLR #17 Marble Beige
K. Installation: Straight Stacked
L. Location: Walls - Locker Rooms
M. Contact: Cristin Hennessy Cristin.Hennessy@VirginiaTile.com

2.15 TL-51LP

A. Distributer: Virginia Tile
B. Manufacturer: VITL
C. Series: Camilla
D. Color: Beige
E. Finish: Polished
F. Size: 24” x 48” Rectified
G. Code: VTLCABE2448P
H. Joint Width: 1/8”
I. Grout: Laticrete CLR #17 Marble Beige
J. Installation: Straight Stacked
K. Location: Walls
L. Contact: Cristin Hennessy Cristin.Hennessy@VirginiaTile.com

2.16 TL-51MP

A. Distributer: Virginia Tile
B. Manufacturer: VITL
C. Series: Camilla
D. Color: Beige
E. Finish: Polished
F. Size: 1 1/4" x 1 1/4", Mosaic
G. Code: VTLCABEMOS11P
H. Joint Width: 1/8”
I. Grout: Laticrete CLR #17 Marble Beige
J. Installation: Straight Stacked
K. Location: Borders and Focal Walls
L. Contact: Cristin Hennessy Cristin.Hennessy@VirginiaTile.com

2.17 TL-52A

A. Distributer: Virginia Tile
B. Manufacturer: VITL
C. Series: Camilla

D.
E. ACTIVE
F. Color: Brown
G. Finish: Matte
H. Size: 12" x 24", Rectified
I. Code: VTLCABR1224R
J. Joint Width: 1/8”
K. Grout: Laticrete CLR #27 Hemp
L. Installation: Third Offset
M. Location: Floors- Locker Bay
N. Contact: Cristin Hennessy Cristin.Hennessy@VirginiaTile.com

2.18 TL-52BP

A. Distributer: Virginia Tile
B. Manufacturer: VITL
C. Series: Camilla
D. Color: Brown
E. Finish: Polished
F. Size: 24" x 24"
G. Code: VTLCABR2424P
H. Joint Width: 1/8”
I. Grout: Laticrete CLR #27 Hemp
J. Installation: Straight Stacked
K. Location: See finish plans
L. Contact: Cristin Hennessy Cristin.Hennessy@VirginiaTile.com

2.19 TL-52F

A. Distributer: Virginia Tile
B. Manufacturer: VITL
C. Series: Camilla
D. Color: Brown
E. Finish: Matte
F. Size: 4" x 24" Installer to cut on site from 12” x 24” (TL-52A)
G. Code: VTLCABR1224R
H. Joint Width: 1/8”
I. Grout: Laticrete CLR #27 Hemp
J. Installation: Straight Stacked
K. Location: Locker Bay Base
L. Contact: Cristin Hennessy Cristin.Hennessy@VirginiaTile.com

2.20 TL-52HP

A. Distributer: Virginia Tile
B. Manufacturer: VITL

C. Series: Camilla
D. Color: Brown
E. Finish: Polished
F. Size: 6" x 48" – Installer to cut on site from 24” x 48” (TL-52LP)
G. Code: VTLCABR2448P
H. Joint Width: 1/8”
I. Grout: Laticrete CLR #27 Hemp
J. Installation: Straight Stacked
K. Location: Café
L. Contact: Cristin Hennessy Cristin.Hennessy@VirginiaTile.com

2.21 TL-52LP

A. Distributer: Virginia Tile
B. Manufacturer: VITL
C. Series: Camilla
D. Color: Brown
E. Finish: Polished
F. Size: 24” x 48”
G. Code: VTLCABR2448P
H. Joint Width: 1/8”
I. Grout: Laticrete CLR #27 Hemp
J. Installation: Straight Stacked
K. Location: Café
L. Contact: Cristin Hennessy Cristin.Hennessy@VirginiaTile.com

2.22 TL-52MP

A. Distributer: Virginia Tile
B. Manufacturer: VITL
C. Series: Camilla
D. Color: Brown
E. Finish: Polished
F. Size: 1 1/4" x 1 1/4", Mosaic
G. Code: VTLCABRMOS11P
H. Joint Width: 1/8”
I. Grout: Laticrete CLR #27 Hemp
J. Installation: Straight Stacked
K. Location: Locker Room Accent
L. Contact: Cristin Hennessy Cristin.Hennessy@VirginiaTile.com

2.23 TL-53B

A. Distributer: Virginia Tile
B. Manufacturer: VITL
C. Series: Pulpis

D. Color: Brown
E. Finish: Matte
F. Size: 24" x 24"
G. Code: LTFTL532424R
H. Joint Width: 1/8”
I. Grout: Laticrete CLR #35 Mocha
J. Installation: See Plans
K. Location: Circulation, Reception, Locker Room walkways, Styling Stations
L. Contact: Cristin Hennessy Cristin.Hennessy@VirginiaTile.com

2.24 TL-53BP

A. Distributer: Virginia Tile
B. Manufacturer: VITL
C. Series: Pulpis
D. Color: Brown
E. Finish: Polished
F. Size: 24" x 24"
G. Code: LTFTL532424P
H. Joint Width: 1/8”
I. Grout: Laticrete CLR #35 Mocha
J. Installation: Stacked
K. Location: Focal Walls
L. Contact: Cristin Hennessy Cristin.Hennessy@VirginiaTile.com

2.25 TL-53CG

A. Distributer: Virginia Tile
B. Manufacturer: VITL
C. Series: Pulpis
D. Color: Brown
E. Finish: Grip
F. Size: 4” x 8”
G. Code: LTFTL5348G
H. Joint Width: 1/8”
I. Grout: Laticrete CLR #35 Mocha
J. Installation: Half Offset
K. Location: Locker Room Shower and Vanity Floors
L. Contact: Cristin Hennessy Cristin.Hennessy@VirginiaTile.com

2.26 TL-53F

A. Distributer: Virginia Tile
B. Manufacturer: VITL
C. Series: Pulpis
D. Color: Brown

E. Finish: Polished
F. Size: 4" x 24" (cut on site from 24" x 24" TL-53B)
G. Code: LTFTL532424R
H. Joint Width: 1/8”
I. Grout: Laticrete CLR #35 Mocha
J. Installation: Stacked
K. Location: Base - See finish plans
L. Contact: Cristin Hennessy Cristin.Hennessy@VirginiaTile.com

2.27 TL-53H

A. Distributer: Virginia Tile
B. Manufacturer: VITL
C. Series: Pulpis
D. Color: Brown
E. Finish: Matte
F. Size: 6" x 24" (cut on site from 24" x 24" TL-53B)
G. Code: LTFTL532424R
H. Joint Width: 1/8”
I. Grout: Laticrete CLR #35 Mocha
J. Installation: Stacked
K. Location: Base at Family Locker
L. Contact: Cristin Hennessy Cristin.Hennessy@VirginiaTile.com

2.28 TL-53LP

A. Distributer: Virginia Tile
B. Manufacturer: VITL
C. Series: Pulpis
D. Color: Brown
E. Finish: Polished
F. Size: 24" x 48"
G. Code: LTFTL532448P
H. Joint Width: 1/8”
I. Grout: Laticrete CLR #35 Mocha
J. Installation: Stacked
K. Location: Locker Room Focal Walls
L. Contact: Cristin Hennessy Cristin.Hennessy@VirginiaTile.com

2.29 TL-53MP

A. Distributer: Virginia Tile
B. Manufacturer: VITL
C. Series: Pulpis
D. Color: Brown
E. Finish: Polished

F. Size: 1 1/4" x 1 1/4", Mosaic
G. Code: LTFTL53MOS11P
H. Joint Width: 1/8”
I. Grout: Laticrete CLR #35 Mocha
J. Installation: Stacked
K. Location: Locker room borders
L. Contact: Cristin Hennessy Cristin.Hennessy@VirginiaTile.com

2.30 TL-54A

A. Distributer: Virginia Tile
B. Manufacturer: VITL
C. Series: Camilla
D. Color: Black
E. Finish: Matte
F. Size: 12" x 24"
G. Code: VTLCABL1224R
H. Joint Width: 1/8”
I. Grout: Laticrete CLR #45 Raven
J. Installation: Third Offset
K. Location: Floors - see finish plans
L. Location: Floors - see finish plans
M. Contact: Cristin Hennessy Cristin.Hennessy@VirginiaTile.com

2.31 TL-54B

A. Distributer: Virginia Tile
B. Manufacturer: VITL
C. Series: Camilla
D. Color: Black
E. Finish: Matte
F. Size: 24" x 24"
G. Code: VTLCABL2424R
H. Joint Width: 1/8”
I. Grout: Laticrete CLR #45 Raven
J. Installation: Straight Stacked
K. Location: Floors - see finish plans
L. Contact: Cristin Hennessy Cristin.Hennessy@VirginiaTile.com

2.32 TL-54BP

A. Distributer: Virginia Tile
B. Manufacturer: VITL
C. Series: Camilla
D. Color: Black
E. Finish: Polished

F. Size: 24" x 24"
G. Code: VTLCABL2424P
H. Joint Width: 1/8”
I. Grout: Laticrete CLR #45 Raven
J. Installation: Straight Stacked
K. Location: Walls - see finish plans and elevations
L. Contact: Cristin Hennessy Cristin.Hennessy@VirginiaTile.com

2.33 TL-54F

A. Distributer: Virginia Tile
B. Manufacturer: VITL
C. Series: Camilla
D. Color: Black
E. Finish: Matte
F. Size: 4" x 24" (cut onsite from 12" x 24" TL-54A)
G. Code: VTLCABL1224R
H. Joint Width: 1/8”
I. Grout: Laticrete CLR #45 Raven
J. Installation: Stacked
K. Location: Base - see finish plans
L. Contact: Cristin Hennessy Cristin.Hennessy@VirginiaTile.com

2.34 TL-54H

A. Distributer: Virginia Tile
B. Manufacturer: VITL
C. Series: Camilla
D. Color: Black
E. Finish: Matte
F. Size: 6" x 24" (cut onsite from 12" x 24" TL-54A)
G. Code: VTLCABL1224R
H. Joint Width: 1/8”
I. Grout: Laticrete CLR #45 Raven
J. Installation: Stacked
K. Location: Floors - see finish plans
L. Contact: Cristin Hennessy Cristin.Hennessy@VirginiaTile.com

2.35 TL-54LP

A. Distributer: Virginia Tile
B. Manufacturer: VITL
C. Series: Camilla
D. Color: Black
E. Finish: Polished
F. Size: 24" x 48"

G. Code: VTLCABL2448P
H. Joint Width: 1/8”
I. Grout: Laticrete CLR #45 Raven
J. Installation: Stacked
K. Location: Base - see finish plans
L. Contact: Cristin Hennessy Cristin.Hennessy@VirginiaTile.com

2.36 TL-55BP

A. Distributer: Virginia Tile
B. Manufacturer: VITL
C. Series: Ourmani
D. Color: Gray
E. Finish: Polished
F. Size: 24" x 24"
G. Code: LTFTL552424P
H. Joint Width: 1/8”
I. Grout: Laticrete CLR #60 Dusty Gray
J. Installation: Stacked
K. Location:Wet Suite Ceiling
L. Contact: Cristin Hennessy Cristin.Hennessy@VirginiaTile.com

2.37 TL-55LP

A. Distributer: Virginia Tile
B. Manufacturer: VITL
C. Series: Ourmani
D. Color: Gray
E. Finish: Polished
F. Size: 24" x 48"
G. Code: LTFTL552448P
H. Joint Width: 1/8”
I. Grout: Laticrete CLR #60 Dusty Gray
J. Installation: Stacked
K. Location:Cafe, Wet Suite, Mens and Womens Shower Focal Walls
L. Contact: Cristin Hennessy Cristin.Hennessy@VirginiaTile.com

2.38 TL-61A

A. Distributer: Virginia Tile
B. Manufacturer: VITL
C. Series: Parchment
D. Color: Beige
E. Finish: Matte/Textured
F. Size: 12" x 24"
G. Code: LTFTL611224

H. Joint Width: 1/8”

I. Grout: Laticrete CLR #17 Marble Beige

J. Installation: Stacked, See finish plans and elevations

K. Location: Studio Portals, Salon Floor, Kids Entry Floor, Kids Restroom floor and wall, Natatorium walls, Steam Room walls, ceilings, and benches

L. Contact: Cristin Hennessy Cristin.Hennessy@VirginiaTile.com

2.39 TL-61AG

A. Distributer: Virginia Tile

B. Manufacturer: VITL

C. Series: Parchment

D. Color: Beige

E. Finish: Grip

F. Size: 12" x 24"

G. Code: LTFTL611224G

H. Joint Width: 1/8”

I. Grout: Laticrete CLR #17 Marble Beige

J. Installation: Stacked

K. Location: Wet Suite Floors, Steam and Sauna Floors

L. Contact: Cristin Hennessy Cristin.Hennessy@VirginiaTile.com

2.40 TL-61F

A. Distributer: Virginia Tile

B. Manufacturer: VITL

C. Series: Parchment

D. Color: Beige

E. Finish: Matte

F. Size: 4" x 24" (cut on site from 12" x 24" TL-61A)

G. Code: LTFTL611224

H. Joint Width: 1/8”

I. Grout: Laticrete CLR #17 Marble Beige

J. Installation: Stacked, See finish plans and elevations

K. Location: Salon base, LT Kid's Entry and Restroom base.

L. Contact: Cristin Hennessy Cristin.Hennessy@VirginiaTile.com

2.41 TL-61T

A. Manufacturer: VITL

B. Series: Parchment

C. Color: Beige

D. Finish: Matte

E. Size: 3" x 24" Bullnose Trim

F. Code: LTFTL61BN324

G. Joint Width: 1/8”

H. Grout: Laticrete CLR #60 Dusty Gray

I. Installation: Stacked

J. Location: Warm Spa and Cold Plunge trim

K. Contact: Cristin Hennessy Cristin.Hennessy@VirginiaTile.com

2.42 TL-62B

A. Distributer: Virginia Tile

B. Manufacturer: VITL

C. Series: Gaia

D. Color: Black

E. Finish: Matte

F. Size: 24" x 24"

G. Code: VTCGEBK2424

H. Joint Width: 1/8”

I. Grout: Laticrete CLR #45 Raven

J. Installation: Stacked

K. Location: Wet Suite and Natatorium Walls

L. Contact: Cristin Hennessy Cristin.Hennessy@VirginiaTile.com

2.43 TL-62T

A. Distributer: Virginia Tile

B. Manufacturer: VITL

C. Series: Gaia

D. Color: Black

E. Finish: Matte

F. Size: 3" x 24" Bullnose Trim

G. Code: VTCGEBKBN324

H. Joint Width: 1/8”

I. Grout: Laticrete CLR #45 Raven

J. Installation: Stacked

K. Location: Stair nosing up to Warm Spa and Cold Plunge, Steam Room benches

L. Contact: Cristin Hennessy Cristin.Hennessy@VirginiaTile.com

2.44 TL-77LP

A. Distributer: Virginia Tile

B. Manufacturer: VITL

C. Series: Alexandria

D. Color: Beige

E. Finish: Polished

F. Size: 24" x 48"

G. Code: VTLAXBE2448PN

H. Joint Width: 1/8”

I. Grout: Laticrete CLR #93 Fossil

J. Installation: Stacked

K. Location: Steam Room Focal Wall

L. Contact: Cristin Hennessy Cristin.Hennessy@VirginiaTile.com

GLASS TILE

3.01 GT-51

A. Vendor: Virginia Tile

B. Manufacturer: Lunada Bay Tile

C. Series: Origami Mosaic

D. Size: Vesper

E. Color: Bari

F. Finish: Pearl

G. Sku: ORG-VESPER-BARI-PRL

H. Grout: Laticrete #09 Frosty

I. Location: See Drawings.

J. Contact: Cristin Hennessy 612-801-6758

K. URL: https://lunadabaytile.com/collections/origami-mosaic/products/vesper?variant=41453365526681

3.02 GT-51A

A. Vendor: Virginia Tile

B. Manufacturer: Lunada Bay Tile

C. Series: Origami Mosaic

D. Size: Vesper Twist

E. Color: Bari

F. Finish: Pearl/Silk

G. Sku: LUNORBRVESTWIST

H. Grout: Laticrete #09 Frosty

I. Location: Locker Room Accent Wall.

J. Installation: Stacked V

K. Contact: Cristin Hennessy 612-801-6758

L. URL: https://lunadabaytile.com/collections/origami-mosaic/products/vesper-twist?variant=41453366116505

POOL TILE, POOL ACCENT TILE, POOL NOSING AND POOL COPING

4.01 1X1 PROFILES AVAILABLE

A. See https://www.daltile.com/products/mosaic/keystones for further details

B. S862 (Bullnose)

C. SC862 (Bullnose Corner)

D. C813 (Cove Base)

E. CB813 (Cove Base Corner for 2x2 Thinset or Conventional Mortar corners)

F. CK813 (Cove Base Corner for 1x1 Thinset or Conventional Mortar corners)

G. S812 (Universal Trim – rounded edge)

4.02 2X2 PROFILES AVAILABLE

A. See https://www.daltile.com/products/mosaic/keystones for further details
B. S886 (Bullnose)
C. SC886 (Bullnose Corner)
D. C833 (Cove Base)
E. SB816 (Cove Base In-Corner)
F. S832 (Universal Trim – rounded edge)
G. SC813 (Cove Base Out-corner for 1x1 or 2x2 cove corners)
H. C701 (Universal Trim – grip edge)

4.03 PC-6:

A. Manufacturer: Buchtal
B. Distributer: Knox Tile
C. Profile (Hand Hold): #55730
D. Profile (Internal Corner): #55732
E. Profile (External Corner): #55736
F. Color: 553001 Blue Active Azure Strip/Grey Beige Body.
G. Finish: Non-slip grip finish.
H. Module Size: 4 3/4" W x 9 5/8" L x 1" D
I. Joint Width: 1/8"
J. Grout above waterline: Laticrete Spectralock + Grout Maximizer CLR #17 Marble Beige
K. Grout below waterline: Laticrete Spectralock + Grout Maximizer CLR #17 Marble Beige
L. Location: Coping at outdoor pools in cold climates.

4.04 TL-101M2

A. Manufacturer: Daltile
B. Pattern: Keystone Mosaics
C. Color: Castle Rock D618
D. Finish: Matte, unglazed
E. Module Size: 2” x 2”
F. Nominal Tile Thickness: 1/4 inch
G. Joint Width: 1/8 inch
H. Grout: Laticrete CLR #60 Dusty Grey
I. Locations: Indoor warm spa and cold plunge bench/stair contrasting trim
J. Profiles:
    1. S886 (Bullnose)
    2. SC886 (Bullnose Corner)
    3. C701 (Universal Trim)
K. Contact: E-mail: Lifetime.fitness@daltile.com, Phone: 877.556.5728
L. URL: https://www.daltile.com/product/Keystones?color=Castlerock&shape=Straight%20Joint

4.05 TL-102M1

A. Manufacturer: Daltile
B. Pattern: Keystone Mosaics

C. Color: Nautical Blue D621
D. Finish: Matte, unglazed
E. Module Size: 1” x 1”
F. Nominal Tile Thickness: 1/4 inch
G. Joint Width: 1/8 inch
H. Grout: Laticrete #44 Bright White
I. Location: Outdoor warm spa waterline.
J. Profiles:
    1. 1" x 1"
K. Contact: E-mail: Lifetime.fitness@daltile.com, Phone: 877.556.5728
L. URL: https://www.daltile.com/product/Keystones?color=Nautical-Blue&shape=Straight%20Joint

4.06 TL-102M2

A. Manufacturer: Daltile
B. Pattern: Keystone Mosaics
C. Color: Nautical Blue D621
D. Finish: Matte, unglazed
E. Module Size: 2” x 2”
F. Nominal Tile Thickness: 1/4 inch
G. Joint Width: 1/8 inch
H. Grout: Laticrete CLR #44 Bright White
I. Location: Lap pool lane lines, targets, and outdoor stair nosing.
J. Profiles:
    1. 2" x 2"
    2. S886 (Bullnose)
    3. SC886 (Bullnose Corner)
K. Contact: E-mail: Lifetime.fitness@daltile.com, Phone: 877.556.5728
L. URL: https://www.daltile.com/product/Keystones?color=Nautical-Blue&shape=Straight%20Joint

4.07 TL-103M2

A. Manufacturer: Daltile
B. Pattern: Keystone Mosaics
C. Color: Arctic White D617
D. Finish: Matte, unglazed
E. Module Size: 2” x 2”
F. Nominal Tile Thickness: 1/4 inch
G. Joint Width: 1/8 inch
H. Grout: Laticrete CLR #44 Bright White
I. Location: Tile trim below waterline at indoor/outdoor lap or leisure pools where universal trim grip edge occurs.
J. Profiles:
    1. 2" x 2"
K. Contact: E-mail: Lifetime.fitness@daltile.com, Phone: 877.556.5728
L. URL: https://www.daltile.com/product/Keystones?shape=Straight%20Joint&color=Arctic-White

4.08 TL-103M2G

A. Manufacturer: Daltile
B. Pattern: Keystone Mosaics
C. Color: Arctic White D617
D. Finish: Abrasive
E. Module Size: 2” x 2”
F. Nominal Tile Thickness: 1/4 inch
G. Joint Width: 1/8 inch
H. Grout: Laticrete #44 Bright White
I. Location: Tiled treads of warm spas, cold spas and outdoor pool stairs – water side, Tiled band at leisure pool zero depth entry.
J. Profiles:
    1. 2” x 2”
K. Contact: E-mail: Lifetime.fitness@daltile.com, Phone: 877.556.5728
L. URL: https://www.daltile.com/product/Keystones?shape=Straight%20Joint&color=Arctic-White

4.09 TL-104M2

A. Manufacturer: Daltile
B. Pattern: Keystone Mosaics
C. Color: Artisan Brown D144
D. Finish: Matte, unglazed
E. Module Size: 2” x 2”
F. Nominal Tile Thickness: 1/4 inch
G. Joint Width: 1/8 inch
H. Grout: Laticrete #57 Hot Cocoa
I. Location: Accent floor tile at indoor pool room, universal trim grip edge at indoor pools, accent floor tile and cove trim at outdoor warm spa, universal trim grip edge at outdoor warm spa, and universal trim grip edge at outdoor pools (pending climate zone, refer to details)
J. Profiles:
    1. 2x2 tile
    2. S886 (Bullnose)
    3. SC886 (Bullnose Corner)
    4. C833 (Cove Base)
    5. C701 (Universal Trim – grip edge)
K. Contact: E-mail: Lifetime.fitness@daltile.com, Phone: 877.556.5728
L. URL: https://www.daltile.com/product/Keystones?shape=Straight%20Joint&color=Arctic-White

4.10 TL-104M2G

A. Manufacturer: Daltile
B. Pattern: Keystone Mosaics
C. Color: Artisan Brown D144
D. Finish: Abrasive
E. Module Size: 2” x 2”
F. Nominal Tile Thickness: 1/4 inch
G. Joint Width: 1/8 inch

H. Grout: Laticrete CLR #57 Hot Cocoa

I. Location: For use only when filed tile DCOF must exceed 0.42

J. Profiles:
   1. 2x2 tile
   2. S886 (Bullnose)
   3. SC886 (Bullnose Corner)

K. Contact: E-mail: Lifetime.fitness@daltile.com, Phone: 877.556.5728

L. URL: https://www.daltile.com/product/Keystones?shape=Straight%20Joint&color=Arctic-White

4.11 TL-105M2

A. Manufacturer: Daltile

B. Pattern: Keystone Mosaics

C. Color: Medium Mottled Brown D050

D. Finish: Matte, unglazed

E. Module Size: 2” x 2”

F. Nominal Tile Thickness: 1/4 inch

G. Joint Width: 1/8 inch

H. Grout: Laticrete CLR #57 Hot Cocoa

I. Location: Field floor tile and cove base trim at indoor pool room, treads at outdoor warm spa

J. Profiles:
   1. 2” x 2”
   2. C833 (Cove Base)
   3. CB813 (Cove Base In-Corner)
   4. SC813 (Cove Base Out-corner for 1x1 or 2x2 cove corners)

K. Contact: E-mail: Lifetime.fitness@daltile.com, Phone: 877.556.5728

L. URL: https://www.daltile.com/product/Keystones?shape=Straight%20Joint&color=Arctic-White

4.12 TL-105M2G

A. Manufacturer: Daltile

B. Pattern: Keystone Mosaics

C. Color: Medium Mottled Brown D050

D. Finish: Abrasive

E. Module Size: 2” x 2”

F. Nominal Tile Thickness: 1/4 inch

G. Joint Width: 1/8 inch

H. Grout: Laticrete CLR #57 Hot Cocoa

I. Location: For use only when field tile DCOF must exceed 0.42

J. Profiles:
   1. 2” x 2”

K. Contact: E-mail: Lifetime.fitness@daltile.com, Phone: 877.556.5728

L. URL: https://www.daltile.com/product/Keystones?shape=Straight%20Joint&color=Arctic-White

4.13 TL-106M2:

A. Manufacturer: Daltile

B. Pattern: Keystone Mosaics

C. Color: Scioto Sand DALD616 (LT Custom)
D. Finish: Matte, unglazed
E. Module Size: 2” x 2”
F. Nominal Tile Thickness: 1/4 inch
G. Joint Width: 1/8 inch
H. Grout: Color to be Selected by Architect
I. Location: Pool
J. Profiles:
    1. 2” x 2”
        a. C833 (Cove Base)
        b. CB813 (Cove Base In-Corner)
        c. SC813 (Cove Base Out-corner for 1x1 or 2x2 cove corners)
K. Contact: E-mail: Lifetime.fitness@daltile.com, Phone: 877.556.5728

STONE TILE

5.01 ST-23:

A. Distributor: Virginia Tile
B. Manufacturer: Island Stone
C. Series: Uniform Cladding
D. Color: Sandstone Mint
E. Finish: Textured (Flamed)
F. Module Size: 15 ½” x 4 ¾”
G. Nominal Tile Thickness: ½ -1”
H. Installation: Butt-jointed
I. Grout: Do NOT grout.
J. Sealer: none.
K. Location: Sauna Accent Wall
L. Contact: Cristin Hennessy, 612-801-6758, Cristin.Hennessy@VirginiaTile.com
M. https://islandstone.com/collections/all/products/stone-textured-wall-tile-uniform-sandstone-mint-chipped?variant=39580204761271

5.02 ST-30:

A. Manufacturer: Tile x Design
B. Stone Type: Woodridge Mini Wall Ledge
C. Color Number: Quartzite WR714
D. Module Size: 7" x 14"
E. Thickness: 3/4"
F. Sealer: none.
G. URL: https://thorntreeslate.com/collections/natural-stone-collections/woodridge-quartzite/woodridge-mini-wall-ledge/

5.03 ST-32:

A. Distributor: Tile x Design
B. Manufacturer: New Ravenna Mosaics

C. Series: Semplice Collection
D. Pattern: Winona – NRWINONA-2
E. Color: Horizon
F. Finish: Honed
G. Repeat: 11 11/16” x 11 11/16”, Repeat SF: .95 SF
H. Joint Width: 1/8 inch
I. Grout: Laticrete CLR #97 Iron
J. Sealer: none.
K. Location: One Wall Street – Coffee Bar
L. Contact: Pam Gilbert – 612 991 4770, pgilbert@tilexdesign.com
M. URL: https://newravenna.com/nr-product/winona-horizon/

5.04 ST-33

A. Distributor: Platform Surfaces
B. Manufacturer: Realstone Systems
C. Color: Pewter Ledgestone
D. Format: Panel 6" x 24" | 1 sq. ft.
   1. Avg. Unit Thickness: 0.4" - 1"
   2. Avg. Unit Weight: 9lbs
E. Finish: Splitface
F. Nosing: N/A
G. Grout: Laticrete CLR #78 Sterling Silver
H. Sealer: none.
I. Location: Exterior, see drawings
J. Contact: Frank Palumbo; 312-860-1904; fpalumbo@platformsurfaces.com
K. URL: https://www.realstonesystems.com/product/pewter-ledgestone-panel/

5.05 ST-34

A. Manufacturer: Daltile
B. Stone Type: Granite, complying with ASTM C615.
C. Color: Absolute Black
D. Finish: Honed
E. Module Size: 12" x 12" (cut to 2" with 1 eased and polished edge)
F. Nominal Tile Thickness: 1/2"
G. Installation: Stacked
H. Grout: Laticrete CLR #60 Dusty Grey
I. Sealer: Stonetech Sealer.
J. Location: Stair nosing
K. Contact: E-mail: Lifetime.fitness@daltile.com, Phone: 877.556.5728
L. URL: https://www.daltile.com/products/Natural-Stone/Granite/Absolute-Black

5.06 ST-35

A. Distributor: Virginia Tile
B. Manufacturer: Island Stone

C. Series: Paragon Hex
D. Color: Sandstone Mint
E. SKU: ISLSAMIPARAHEX
F. Finish: Honed
G. Module Size: mosaic
H. Nominal Tile Thickness: 12.7mm
I. Installation: Hexagon
J. Grout: no grout.
K. Location: Outdoor Bar focal
L. Contact: Cristin Hennessy, 612-801-6758, Cristin.Hennessy@VirginiaTile.com
M. URL: https://islandstone.com/collections/all/products/stone-dimensional-tile-paragon-hex-sandstone-mint-honed?variant=39580202664119

5.07 ST-36

A. Manufacturer: AKDO
B. Series: Pose Fino
C. Color: Moss Green (H)
D. SKU: MB1088-FINOH0
E. Finish: Honed
F. Module Size: 7.87" x 9.29"
G. Nominal Tile Thickness: 3/8"
H. Installation: Horizontal
I. Grout: Laticrete CLR #17 Marble Beige
J. Sealer: Stonetech Sealer
K. Location: Cafe and Indoor Bar
L. Contact: Lynn Deschamps lynn.deschamps@akdo.com
M. URL: https://professional.akdo.com/materials/stone/mosaics/fino/8486188-pose-fino-moss-green-h/

5.08 ST-37A:

A. Manufacturer: Daltile
B. Stone Type: Uba Tuba
C. Color: G761
D. Finish: Flamed
E. Module Size: 12" x 24" x 3/8"
F. Nominal Tile Thickness: 3/8 inch
G. Joint Width: 1/4 inch
H. Grout: Laticrete CLR #60 Dusty Grey
I. Sealer: Stonetech Sealer
J. Installation: Stacked
K. Location: Grand Stair, Entry Vestibule
L. Contact: E-mail: Lifetime.fitness@daltile.com, Phone: 877.556.5728
M. URL: http://daltilestonecenter.com/StGeorge/ProductDetail.aspx?ID=682

5.09 ST-37F:

A. Manufacturer: Daltile
B. Stone Type: Uba Tuba
C. Color: G761
D. Finish: Flamed
E. Module Size: 4" x 24" x 3/8" (cut on site from 12" x 24" ST-37A)
F. Nominal Tile Thickness: 3/8 inch
G. Joint Width: 1/4 inch
H. Grout: Laticrete CLR #60 Dusty Grey
I. Sealer: Stonetech Sealer
J. Installation: Stacked
K. Location: Entry Vestibule
L. Contact: E-mail: Lifetime.fitness@daltile.com, Phone: 877.556.5728
M. URL: http://daltilestonecenter.com/StGeorge/ProductDetail.aspx?ID=682

METAL EDGE STRIPS

6.01 L-SHAPED PROFILE

A. Manufacturers and products:
   1. Schluter: Jolly
   2. Laticrete: L-shaped edge.
   3. Or approved equal.
B. Description: L-shaped profile with 1/8" (3.2mm) wide top section and vertical wall section that together form the visible surface, integrated perforated anchoring leg and integrated grout joint spacer.
C. Anchoring Leg:
   1. Provide with straight anchoring leg.
   2. Provide with special radius anchoring leg for radius application.
D. Material and Finish: Brushed antique bronze anodized aluminum or as selected by Architect.
E. Height: As required
F. Location: Tile Edge protection as indicated on drawings.

6.02 COVE PROFILE

A. Manufacturers and products:
   1. Schluter: DILEX-AHK
   2. Laticrete: Cove Profile
   3. Or approved equal.
B. Description: Anodized aluminum profile with integrated perforated anchoring leg, connected at a 90-degree angle by a cove-shaped section with 3/8" (10mm) radius that forms the visible surface.
C. Corners/End Caps/Connectors: Provide matching units.
D. Material and Finish: Satin Nickel Anodized Aluminum, or as selected by architect.
E. Height: As required.
F. Location: Wet areas throughout.

6.03 EXPANSION JOINT

A. Manufacturers and products:
   1. Schluter: DILEX-BWB
   2. Laticrete: Expansion and movement profile, Style 4.
   3. Or approved equal.

B. Description: Stainless Steel profile with integrated perforated anchoring legs connected by 15/32" wide tongue and groove joint that forms the visible surface.

C. Corners/End Caps/Connectors: Provide matching units.

D. Material and Finish: E- Stainless Steel type 304 = V2A

E. Location: Exterior Tile expansion joints.

6.04 CORNER EXPANSION JOINT

A. Manufacturer: Schluter
   1. Series: DILEX-EKE
   2. Or approved equal.

B. Description: Profile with integrated rigid, recycled PVC perforated anchoring legs, connected at a 90-degree angle by a 3/16" (5mm) wide soft CPR movement zone that forms the visible surface.

C. Movement Zone Color: Light Beige

D. Height: As required

E. Location: Steam Room and Sauna

6.05 DECORATIVE ACCENT PROFILE

A. Manufacturers and products:
   1. Schluter: DESIGNLINE
   2. Laticrete: Decorative Border Profile (DB1)
   3. Or approved equal.

B. Description: Vertical tile divider. 1" wide

C. Material and Finish: ATGB brushed nickel anodized aluminum or as selected by architect

D. Height: As required. See drawings

6.06 TILE FLOOR EDGE TRANSITION

A. Manufacturer: Schluter
   1. Series: RENO RAMP
   2. Laticrete: Transition profile (TR4)
   3. Or approved equal.

B. Description: Material transition

C. Material and Finish: Anodized Aluminum, or as selected by architect

D. Height: As required

E. Location: Transition between tile and concrete

6.07 TILE FLOOR SAME HEIGHT TRANSITION

A. Manufacturers and products:
   1. Schluter: DECO
   2. Laticrete:
   3. Or approved equal.

B. Description: Same height transition.

C. Material and Finish: Solid Brass, or as selected by Architect.

D. Height: As required

E. Location: Transition between tiles, Transition between tile and contrasting stone strip at Grand Stair Nosing.

6.08 SQUARE OUTSIDE CORNER

A. Manufacturers and products:
   1. Schluter: QUADEC

2. Or approved equal.

B. Laticrete: Square edge profile (SQ2)

C. Description: Edge Protection

D. Material and Finish: As selected by architect

E. Height: As required.

SCHEDULE OF FACEPLATE AND WIRING DEVICES COLORS BY WALL FINISH:

7.01 WHITE FACEPLATES ARE TO BE USED ON WALLS WITH THE FOLLOWING FINISHES"

A. TL-1 (series)

B. TL-11 (series)

C. TL-22 (series)

D. TL-24 (series)

E. TL-27 (series)

7.02 ALL OTHER FACEPLATES AND WIRING DEVICES INSTALLED ON TILE ARE TO BE BLACK.

END OF SECTION

SECTION 09 51 13
ACOUSTICAL PANEL CEILINGS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Acoustical ceiling tiles and exposed suspension systems for ceilings.

B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete at ceilings.

1.02 RELATED REQUIREMENTS

A. Section 01 33 00 - Submittal Procedures.

B. Section 01 40 00 - Quality Requirements.

C. Section 01 60 00 - Product Requirements.

D. Section 01 92 00 - Facility Operation and Maintenance.

E. Section 05 21 00 - Steel Decking.

F. Section 07 92 00 - Joint Sealants.

G. Section 09 21 16 - Gypsum Board Assemblies.

H. Section 09 51 14 - Acoustic Panel Ceilings Schedule.

I. Section 09 74 16 - Flexible Wood Veneer Wall Covering.

J. Section 09 84 14 - Acoustic Stretched-Fabric Wall Systems.

K. Section 09 84 30 - Sound Absorbing Wall and Ceiling Units.

L. Section 09 91 00 - Painting.

1.03 REFERENCE STANDARDS

A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

B. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire; 2019.

C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

D. ASTM C635/C635M - Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2022.

E. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2019.

F. ASTM D3274 - Standard Test Method for Evaluating Degree of Surface Disfigurement of Paint Films by Fungal or Algal Growth, or Soil and Dirt Accumulation; Current Edition, Including All Revisions.

G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

H. ASTM E795 - Standard Practices for Mounting Test Specimens during Sound Absorption Tests; 2023.

I. ASTM E1190 - Standard Test Methods for Strength of Power-Actuated Fasteners Installed in Structural Members; Current edition.

J. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2023.

K. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, with Editorial Revision (2021).

L. CISCA (AC) - Acoustical Ceilings: Use and Practice; 1999.

M. NAAMM AMP 500-06 - Metal Finishes Manual; 2006.

1.04 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.
   1. Acoustical Panel: Set of 6-inch- (150-mm-) square Samples of each type, color, pattern, and texture.
   2. Exposed Suspension System Members, Moldings, and Trim: Set of 12-inch- (300-mm-) long Samples of each type, finish, and color.

C. Research/Evaluation Reports: For each acoustical panel ceiling and components and anchor and fastener type.

D. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.
   3. See Sections 01 33 00 and 01 60 00.

E. Operation and Maintenance Data: Submit O&M manuals according to the requirements of Section 01 92 00 - Facility Operation and Maintenance.

F. Delegated-Design Submittal: For seismic restraints for ceiling systems.
   1. Include design calculations for seismic restraints including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.05 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system through one source from a single manufacturer.

C. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:
   1. Surface-Burning Characteristics: Provide acoustical panels with the following surface-burning characteristics complying with ASTM E1264 for Class A materials as determined by testing identical products per ASTM E84.

D. Engineering Responsibility: Preparation of shop drawings, design calculations and other structural data by a qualified professional engineer.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of cold-formed metal framing that are similar to those indicated for this Project in material, design and extent.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.07 PROJECT CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient

temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

1.08 COORDINATION

A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.09 SYSTEM DESCRIPTION

A. Loading:
   1. Design and size components to withstand gravity and seismic loads in accordance with the building code. See ASCE 7, Chapter 13.

B. See Architectural Drawings Sheet G010 for Seismic Design Category designation.

C. Structural Performance. See ASCE 7, 13.5.6:
   1. IBC Seismic Categories C
      a. Heavy Duty Grid.
      b. Design and install in accordance with ASTM C635/C635M and ASTM C636/C636M.
      c. Interior suspended ceilings, soffits, and bulkheads: Maintain deflection of not more than L/360 of distance between supports.

D. Seismic Standard: Provide acoustical panel ceilings designed and installed to withstand the effects of earthquake motions according to the following:
   1. Delegated Design: Engage a qualified professional engineer, licensed in the State of Utah, to design seismic restraints for ceiling systems.
   2. Suspended ceilings shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

PART 2 PRODUCTS

2.01 ACOUSTICAL PANELS, GENERAL

A. Recycled Content: Provide acoustical panels with recycled content such that postconsumer recycled content plus one-half of pre-consumer recycled content constitutes a minimum of 5 percent by weight.

B. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E1264 classifications as designated by types, patterns, acoustical ratings, and light reflectance, unless otherwise indicated.
   1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches (400 mm) away from test surface per ASTM E795.

C. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.

D. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D3274 and evaluated according to ASTM D3274 or ASTM G21.

2.02 ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING

A. See Attached Schedule.

B. Classification: Provide panels complying with ASTM E1264.

2.03 METAL SUSPENSION SYSTEMS, GENERAL

A. Recycled Content: Provide products made from steel sheet with average recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.

B. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C635/C635M.

C. Finishes and Colors, General: Comply with NAAMM AMP 500-06 "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.

D. Attachment Devices: Size for five times the design load indicated in ASTM C635/C635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
   1. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated, and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing per ASTM E1190, conducted by a qualified testing and inspecting agency.

E. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
   1. Zinc-Coated, Carbon-Steel Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper.
   2. Size: Select wire diameter so its stress at 3 times hanger design load (ASTM C635/C635M, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch-(2.69-mm-) diameter wire.

F. Hanger Rods Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.

2.04 METAL SUSPENSION SYSTEM FOR ACOUSTICAL PANEL CEILING

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include the following:
   1. See Schedule.

B. Capped, Double-Web, Hot-Dip Galvanized, G30 Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, hot-dip galvanized according to ASTM A653/A653M, G30 coating designation, with prefinished, cold-rolled, aluminum caps on flanges.
   1. See schedule for width.
   2. Structural Classification: See part 1.10 above for requirements.
   3. Face Design: Flat, flush.
   4. Face Finish: White satin. Unless noted otherwise.

C. ACT hold-down clips and related materials.
   1. Hold-Down Clips: Manufacturer's standard hold-down.
   2. Impact Clips: Manufacturer's standard impact-clip system designed to absorb impact forces against acoustical panels.
   3. Seismic Clips: Manufacturer's standard seismic clips designed to secure acoustical panels in place during a seismic event.
   4. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.
   5. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.

2.05 METAL EDGE MOLDINGS AND TRIM

A. Products: Subject to compliance with requirements, provide the following:
   1. See Schedule.

B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Manufacturer's standard flat wall angle, unless other profile indicated, for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.

C. Fasteners: Shall be prefinished or painted white.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.03 ACOUSTICAL PANEL CEILING INSTALLATION

A. General: Based on Seismic Design Category, install acoustical panel ceilings to comply with ASTM C636/C636M and seismic design requirements indicated, per manufacturer's written instructions and CISCA (AC) "Ceiling Systems Handbook".
   1. Install suspension systems with hangers supported only from building structural members. Locate hangers not less than 6 inches from each end and spaced 4'-0" along each carrying channel or direct-hung runner, unless otherwise indicated, leveling to tolerance of 1/8" in 12'-0". Comply with detail on drawings for seismic bracing.

B. Suspend ceiling hangers from building's structural members and as follows:
   1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
   2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, counter-splaying, or other equally effective means.
   3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
   4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
   5. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, post-installed mechanical or adhesive anchors, or powder-actuated fasteners that extend through forms into concrete.
   6. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
   7. Do not attach hangers to steel deck tabs.
   8. Do not attach hangers to steel roof deck.
   9. Attach hangers to structural members.
   10. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.
   11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or post-installed anchors.

D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3.2 mm in 3.6 m). Miter corners accurately and connect securely.
2. Do not use exposed fasteners, including pop rivets, on moldings and trim.

E. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

F. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
1. Arrange directionally patterned acoustical panels as follows:
   a. Install panels with pattern running in one direction parallel to long axis of space.
2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.

G. Install acoustical panel hold-down clips at ACT-1 installed in entry vestibule.

3.04 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, suspended decorative grid ceiling systems, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

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SECTION 09 51 14
ACOUSTICAL PANEL CEILING - SCHEDULE

ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING

1.01 ACT-2:

A. Manufacturer: Armstrong

B. Product: Ultima Vector #1920

C. Color: White

D. LR: 0.86

E. NRC: 0.7

F. CAC: 35

G. Edge Detail: Angled Tegular

H. Thickness: 3/4”

I. Size: 24”’ x 24”

J. Metal Suspension System
   1. Manufacturer: Armstrong
   2. Product: Suprafine
   3. Size: 9/16”

K. Color: White Satin

L. Location: Coffee Bar

M. Contact: Lisa Cavataio E-mail: lycavataio@armstrongceilings.com Phone: 773-882-0299

N. URL: https://www.armstrongceilings.com/commercial/en/commercial-ceilings-walls/ultima-vector-ceiling-tiles/item/1920.html

1.02 ACT-7

A. Manufacturer: USG Interiors, Inc.; Sheetrock brand Clima Plus Vinyl No. 3260

B. Type and Form: Type XX, other types; described as high-density, ceramic- and mineral-base panels with scrubbable finish, resistant to heat, moisture, and corrosive fumes

C. Pattern: G (smooth)

D. Color: White

E. LR: Not less than 0.77

F. NRC: Not less than .1

G. CAC: Not less than 35

H. Edge/Joint Detail: Square

I. Thickness: 1/2".

J. Modular Size: 24 by 24"

K. Metal Suspension System.
   1. Manufacturer: USG
   2. Product: Donn DX
   3. Size: 15/16”
   4. Color: Flat White

L. Location: Cafe Service, Kitchen, Bistro

M. URL: https://www.usg.com/content/usgcom/en/products/ceilings/ceiling-tiles-panels/acoustical-panels/sheetrock-lay-in-gypsum-acoustical-panels.3260.html

1.03 ACT-15

A. Manufacturer: Armstrong
B. Product: Calla Square Lay-In
C. Color: Stone (SE)
D. LR: 0.86
E. NRC: 0.85
F. CAC: 35
G. Edge Detail: 9/16” Square Tegular
H. Thickness: 1”
I. Size: 24”’ x 24”
J. Metal Suspension System
    1. Manufacturer: Armstrong
    2. Product: Suprafine
    3. Size: 9/16”
    4. Color: Stone
K. Location: Coffee Bar
L. Contact: Lisa Cavataio E-mail: lycavataio@armstrongceilings.com Phone: 773-882-0299
M. URL: https://www.armstrongceilings.com/content/dam/armstrongceilings/commercial/north-america/brochures/calla-brochure.pdf

1.04 ACT-19:

A. Manufacturer: Armstrong
B. Product: 6487F01W3NWN Woodwork Tegular
C. Color: Plain Slice Walnut
D. NRC: 0.50
E. CAC: 28
F. Edge Detail: 6" WoodWorks Trim 5419W1
G. Thickness: .75"
H. Size: 24" x 72"
I. Install: Hangar Rib/Threaded Rod
J. Accessories and Trim: by Manufacturer
K. Acoustical Suspension System:
    1. Manufacturer: Armstrong Commercial
    2. Product: Suprafine Square Tegular
    3. Size: 9/16”
    4. Color: Bronze
    5. Install: Hangar Rib/Threaded Rod
L. Location: Life Time Work
M. Contact: Lisa Cavataio E-mail: lycavataio@armstrongceilings.com Phone: 773-882-0299
N. URL: https://www.armstrongceilings.com/commercial/en/commercial-ceilings-walls/woodworks-tegular-ceiling-tiles/item/6487W3.html

1.05 ACT-19B:

A. Manufacturer: Armstrong
B. Product: 6487W3 Woodwork Tegular (Perforated)

C. Color: Natural Variations Plain Slice Walnut

D. NRC: 0.50

E. CAC: 38

F. Edge Detail: 6" WoodWorks Trim 5419W1

G. Thickness: .75"

H. Size: 24" x 72"

I. Install: Hangar Rib/Threaded Rod

J. Accessories and Trim: by Manufacturer

K. Acoustical Suspension System:
   1. Manufacturer: Armstrong Commercial
   2. Product: Suprafine Square Tegular
   3. Size: 9/16”
   4. Color: Bronze

L. Install: Hangar Rib/Threaded Rod

M. Location: Life Time Work

N. Contact: Lisa Cavataio E-mail: lycavataio@armstrongceilings.com Phone: 773-882-0299 N.

O. URL: https://www.armstrongceilings.com/commercial/en/commercial-ceilings-walls/woodworks-tegular-ceiling-tiles/item/6487W3.html

1.06 ACT-20:

A. Manufacturer: Armstrong

B. Product: 6723F51L4T5 Woodwork Tegular

C. Color: Warm Oak

D. NRC: 0.50

E. CAC: 28

F. Edge Detail: 6" WoodWorks with 4 Clips 7146H6L96

G. Thickness: 2"

H. Size: 24" x 48"

I. Install: Hangar Rib/Threaded Rod

J. Acoustical Suspension System:
   1. Manufacturer: Armstrong Commercial
   2. Product: Suprafine Square Tegular
   3. Size: 15/16”
   4. Color: Bronze
   5. Install: Hangar Rib/Threaded Rod

K. Location: Life Time Work

L. Contact: Lisa Cavataio E-mail: lycavataio@armstrongceilings.com Phone: 773-882-0299

M. URL: https://www.armstrongceilings.com/commercial/en/commercial-ceilings-walls/woodworks-grille-tegular-ceiling-tiles.html

1.07 ACT-21

A. Manufacturer: Armstrong

B. Product: Lyra 8357PBWBS

C. Color: Brown Sugar Walnut

D. NRC: 0.95

E. Edge Detail: Axiom trim.
   1. Size: 4" nom
   2. Color: Coffee (SCE). SW6258
F. Thickness: 1"
G. Size: 24" x 48"
H. Install: Hangar Rib/Threaded Rod
I. Acoustical Suspension System:
   1. Manufacturer: Armstrong Commercial
   2. Product: Suprafine XL
   3. Size: 9/16”
   4. Color: Black
   5. Install: Hangar Rib/Threaded Rod
J. Location: Yoga Foyer.
K. Contact: Lisa Cavataio E-mail: lycavataio@armstrongceilings.com Phone: 773-882-0299
L. URL: https://www.armstrongceilings.com/commercial/en/commercial-ceilings-walls/woodworks-grille-tegular-ceiling-tiles.html

1.08 ACT-100

A. Manufacturer: USG
B. Product: Mars Clima Plus
C. Code: No. 86985
D. Color: White
E. NRC: 0.75
F. CAC: 35
G. LR: 0.90
H. Edge Detail: FLB
I. Thickness: 3/4"
J. Size: 24" x 24"
K. Metal Suspension System
   1. Manufacturer: USG
   2. Product: Centricitee DXT
   3. Size: 9/16"
   4. Wall Angle: M7
      a. Wall angle dimension: 7/8"
   5. Color: Flat White 050
L. Location: Where indicated on drawings.
M. Contact: Lisa Cavataio E-mail: lycavataio@armstrongceilings.com Phone: 773-882-0299
N. URL: https://www.usg.com/content/usgcom/en/products/ceilings/ceiling-tiles-panels/acoustical-panels/mars-acoustical-panels.86985.html

1.09 ACT-100B

A. Manufacturer: USG
B. Product: Mars Clima Plus
C. Code: No. 88985
D. Color: White
E. NRC: 0.75

F. CAC: 35

G. LR: 0.90

H. Edge Detail: FLB

I. Thickness: 3/4"

J. Size: 24" x 48"

K. Metal Suspension System
   1. Manufacturer: USG
   2. Product: Compasso
   3. Size: 9/16"
   4. Wall Angle: Standard 4"
      a. Wall angle dimension: 4" x 9/16"
   5. Color: Flat White 050

L. Location: Cycle, Group #1 & 2, Barre, Pilates and Yoga / MB360..

M. URL: https://www.usg.com/content/usgcom/en/products/ceilings/ceiling-tiles-panels/acoustical-panels/mars-acoustical-panels.86985.html

1.10 ACT-101

A. Manufacturer: USG

B. Product: Mars Clima Plus - High NRC

C. Code: No. 88139

D. Color: White

E. NRC: 0.90

F. CAC: 30

G. LR: 0.90

H. Edge Detail: FLB

I. Thickness: 1"

J. Size: 24" x 24"

K. Metal Suspension System
   1. Manufacturer: USG
   2. Product: Centricitee DXT
   3. Size: 9/16"
   4. Color: Flat White 050Location: Life Time Work: Typical throughout
   5. URL: https://www.usg.com/content/usgcom/en/products/ceilings/ceiling-tiles-panels/acoustical-panels/mars-acoustical-panels.86985.html

SCHEDULE OF FACEPLATE AND WIRING DEVICES COLORS BY WALL FINISH:

3.01 BROWN FACEPLATES ARE TO BE USED ON WALLS WITH THE FOLLOWING FINISHES:

A. ACT-19

B. ACT-21

3.02 ALL OTHER FACEPLATES AND WIRING DEVICES INSTALLED ON ACT CEILINGS ARE TO BE WHITE.

END OF SECTION

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SECTION 09 54 23
LINEAR METAL CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Linear metal ceilings.
   1. Interior Application.
   2. Exterior Application.

1.02 RELATED REQUIREMENTS

A. Section 01 33 00 - Submittal Procedures.

B. Section 01 40 00 - Quality Requirements.

C. Section 01 60 00 - Product Requirements.

D. Section 01 92 00 - Facility Operation and Maintenance.

E. Section 05 21 00 - Steel Decking.

F. Section 07 92 00 - Joint Sealants.

G. Section 09 21 16 - Gypsum Board Assemblies.

H. Section 09 51 13 - Acoustical Panel Ceilings.

1.03 REFERENCE STANDARDS

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

B. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.

C. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

D. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method; 2023.

E. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2019.

F. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2023.

G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

H. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.

I. ASTM E413 - Classification for Rating Sound Insulation; 2022.

J. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2022.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate work of this section with installation of mechanical and electrical components and with other construction activities affected by work of this section.

B. Preinstallation Meeting: Convene one week before starting work of this section.

C. Sequencing: Supply hanger clips during steel deck erection. Supply additional hangers and inserts as required.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Furnish for component profiles.

C. Shop Drawings: Indicate reflected ceiling plan.

D. Samples: Submit two samples illustrating color and finish of components exposed to view.

E. Installer's qualification statement.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Extra Linear Panels: Ten, standard length.

G. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.
   3. See Sections 01 33 00 and 01 60 00.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the work of this section.
   1. Approved by metal ceiling manufacturer.

B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc.

1.07 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 74 19 - Construction Waste Management and Disposal for packaging waste requirements.

1.08 WARRANTY

A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.

B. Manufacturer Warranty: Provide 1 manufacturer warranty; include coverage for corrosion resistance and discoloration of surface finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Linear Metal Ceilings:
   1. Certainteed; Box Series:
      a. LMC-2B, Interior Application:
         1) Series: Deep Box 4
         2) Color: Regatta Teak
         3) Size: 4" x 16'-0"
         4) Panel Depth: 1"
         5) Carrier Spacing: 4' OC.
         6) Acoustic Panel Backer: 1 1/2" Polywrapped Fiberglass.
         7) Overall Depth: 2 1/8"
         8) Contact: Paul Teagan; 763.475.1340
         9) URL: https://certainteed.widen.net/view/pdf/awqtqqgj2s/metal-box-series-data-sheet-e-us-2206ctc.pdf?t.download=true&u=ictwif
      b. LMC-2C, Exterior Application:
         1) Series: Deep Box 4
         2) Color: Regatta Teak
         3) Size: 4" x 16'-0"
         4) Panel Depth: 1"
         5) Carrier Spacing: 2' OC.
         6) Acoustic Panel Backer: None, provide black metal filler strip by Manufacturer.
         7) Overall Depth: 2 1/8"
         8) Contact: Paul Teagan; 763.475.1340
         9) URL: https://certainteed.widen.net/view/pdf/awqtqqgj2s/metal-box-series-data-sheet-e-us-2206ctc.pdf?t.download=true&u=ictwif
   2. Substitutions: Not permitted.

2.02 LINEAR METAL CEILINGS

A. Linear Metal Ceiling System: Panels, suspension members, trim, and accessories as required to provide a complete system.

B. Performance Requirements:
   1. Design to support imposed loads of indicated items without eccentric loading of supports.
   2. Design for maximum deflection of 1/360 of span.
   3. Surface Burning Characteristics: Flame spread index of >25, smoke developed index of >50, when tested in accordance with ASTM E84.

2.03 COMPONENTS

A. Linear Metal Panels:
   1. Type: Linear panel with reveals; snap-in installation.
      a. Size and Configuration: As indicated on drawings.
      b. Panel Profile: Box shaped.
      c. Spacing: 3/4 inch (18 mm) reveal between panels.
   2. Material: Aluminum sheet, ASTM B209/B209M.
      a. Finish: Wood Veneer. See above for type.

B. Edge Molding, Expansion Joints, and Splices: Same material, thickness, and finish as linear panels. Matte finish, Black.
   1. Metal Filler Strip: As recommended by Manufacturer for Exterior Application.

C. End Caps: Formed metal; same color and finish as sight-exposed surfaces of linear panels.

D. Accessories: Stabilizer bars as required for suspended grid system; sight-exposed surfaces same color and finish as sight-exposed surfaces of linear panels.

E. Suspension Members: Formed steel sections, with integral attachment points; galvanized finish; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.

F. Suspension Wire: Steel, annealed, galvanized finish, 9 gauge, 0.1144 inch (2.91 mm) diameter.

G. Subgirt Members: Hot-dip galvanized steel sheet, ASTM A653/A653M, with G90/Z275 coating; formed to resist imposed loads and to provide attachment for linear ceiling and accessories.

H. Insulation: Acoustical Insulation where indicated.
   1. Polywrapped Fiberglass acoustic insulation by Manufacturer.
      a. Thickness: 1.5"
      b. Density: 1.5 pcf.
      c. Color: Black.
      d. Finish: Matte.

2.04 COORDINATION WITH WORK OF OTHER SECTIONS

A. Color of faceplates and wiring devices installed in linear metal ceilings:
   1. Brown.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that layout of hangers will not interfere with other work.

C. Verify that required utilities are available, in proper location, and ready for use.

D. Verify that field measurements are as indicated.

3.02 INSTALLATION

A. Suspension Components:
   1. Install after above-ceiling work is complete in accordance with manufacturer's instructions, ASTM C636/C636M, and ASTM E580/E580M.

2. Hang carrying members independent of walls, columns, ducts, light fixtures, pipe, and conduit; where carrying members are spliced, avoid visible displacement of face panels with adjacent panels.
3. Where ducts or other equipment prevent regular spacing of hangers, reinforce nearest adjacent hangers to span the required distance.

B. Linear Metal Ceiling:
1. Install linear panels, baffles, and other system components in accordance with manufacturer's instructions.
2. Stagger end joints minimum 12 inches (300 mm).
3. Provide expansion joints to accommodate plus or minus 1 inch (25 mm) movement and maintain visual closure.
4. Install end caps at sight-exposed ends of linear panels.
5. Exercise care when site cutting sight-exposed finished components to ensure surface finish is not defaced.

C. Insulation: Install above panel members; fit tight between grid members; place insulation with facing side down.

3.03 CLEANING

A. Clean exposed surfaces.

B. Replace damaged or abraded components.

END OF SECTION

SECTION 09 65 19
RESILIENT FLOORING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Rubber tile flooring.
   2. Vinyl composition floor tile.
   3. Static dissipative tile, with copper grounding strips.
   4. Luxury vinyl plank floor tile.
   5. Resilient Sheet/Roll flooring.
   6. Resilient molding accessories.
   7. Floor paint.

1.02 RELATED SECTIONS

A. Section 01 33 00 - Submittal Procedures.

B. Section 01 40 00 - Quality Requirements.

C. Section 01 60 00 - Product Requirements.

D. Section 01 92 00 - Facility Operation and Maintenance.

E. Section 03 30 00 - Cast in Place Concrete.

F. Section 09 05 61 - Common Work Results for Flooring Preparation.

G. Section 09 30 00 - Tile.

H. Section 09 64 00 - Wood Flooring.

I. Section 09 64 66 - Wood Athletic Flooring.

J. Section 09 65 20 - Resilient Tile Flooring Schedules.

K. Section 09 64 66 - Wood Athletic Flooring.

L. Section 09 65 66 - Resilient Athletic Sports Surface.

M. Section 09 68 13 - Tile Carpeting.

1.03 REFERENCE STANDARDS

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emissions Standards for Consumer and Commercial Products; Current Edition.

B. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2022.

C. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2023.

D. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.

E. GBC, Section 5.504.4.6 - Resilient flooring systems.

1.04 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Verification: Full-size units of each color and pattern of floor tile required.

C. Samples for Color Selection: For each of the following items.
   1. Floor Transitions.
   2. Stair Nosings.

D. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.

3. See Sections 01 33 00 and 01 60 00.

E. Operation and Maintenance Data: Submit O&M manuals according to the requirements of Section 01 92 00 - Facility Operation and Maintenance.

1.05 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for flooring installation indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store flooring and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 90 deg F (32 deg C). Store floor tiles on flat surfaces.

1.07 PROJECT CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 65 deg F (18 deg C) or more than 86 deg F (30 deg C), in spaces to receive floor tile during the following time periods:
   1. 48 hours before installation.
   2. During installation.
   3. 48 hours after installation.

B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 65 deg F (18 deg C) or more than 86 deg F (30 deg C).

C. Close spaces to traffic during flooring installation.

D. Close spaces to traffic for 48 hours after flooring installation.

E. Install flooring after other finishing operations, including painting, have been completed.

1.08 WARRANTY

A. Provide Manufacturer's standard warranty for each tile/system.

PART 2 PRODUCTS

2.01 RUBBER FLOOR TILE

A. See Attached Schedule.

2.02 VINYL COMPOSITION FLOOR TILE

A. See Attached Schedule.

2.03 STATIC DISSIPATIVE TILE FLOORING

A. See Attached Schedule.

2.04 LUXURY VINYL PLANK TILE

A. See Attached Schedule.

2.05 RESILIENT ROLL/SHEET FLOORING

A. See Attached Schedule

2.06 RESILIENT BASE

A. See Attached Schedule.

2.07 VINYL RESILIENT BASE

A. See Attached Schedule.

2.08 RESILIENT MOLDING ACCESSORIES

A. Flooring Transition:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Johnsonite. (Basis of Design)
    b. Armstrong World Industries, Inc.
    c. Roppe Corporation, USA.
    d. VPI, LLC; Floor Products Division.
2. Description: Carpet edge, reducer strip for resilient floor covering, and transition strips.
3. Material: Rubber.
4. Profile and Dimensions: As indicated.
5. Transition type:
    a. LVT to Isolated floor slab:
        1) Manufacturer: Johnsonite
        2) Product: CD-XX-C and Track Base MT-00A
        3) Color: TB1 Peppercorn
        4) Location: Yoga, Group Fitness, see drawings.
    b. LVT to VCT:
        1) Manufacturers: Johnsonite
        2) Product: SLT-XX-A Slimline Transition
        3) Color: TB1 Peppercorn
        4) Location: Fitness Floor
    c. LVT to CPT:
        1) Manufacturers: Johnsonite
        2) Product: SLT-XX-F Slimline Transition
            (a) Color: TB1 Peppercorn
        3) Location: Spa Treatment to waiting
    d. LVT to Resilient Athletic Sports Surface (Racquet Sports):
        1) Manufacturer and Products:
            (a) Schluter Vinpro-U
            (b) Laticrete: Transition TR1
        2) Finish: Brushed chrome anodized aluminum (ACGB)
        3) Dimension: Coordinate with LVT depth
        4) Location: Pickleball
    e. LVT to Resilient Sheet Flooring or Rubber Tile Flooring:
        1) Manufacturer: Johnsonite
        2) Product: CD-XX-X and Track Base MT-00A
        3) Color: TB1 Peppercorn
        4) Dimension: Coordinate with flooring depths
        5) Location: Fitness Floor, LT Kid's Gym, and Movement Studio
    f. Rubber Floor to Resilient Sheet Flooring
        1) Manufacturer: Johnsonite
        2) Product: CCA-XX Adaptor
        3) Color: TB1 Peppercorn
        4) Location: Group Fitness Studio to Fitness Floor
    g. Resilient Sheet Flooring (RSF-3) to Resilient Sheet Flooring (RSF-4)
        1) Manufacturer: Johnsonite
        2) Product: CD-XX-X and Track Base MT-00A
        3) Color: TB1 Peppercorn
        4) Location: Movement Studio
    h. Resilient Sheet Flooring to Concrete
        1) Manufacturers: Johnsonite
        2) Product: CD-XX-X and Track Base MT-00A
        3) Color: TB1 Peppercorn

4) Dimension: Coordinate with flooring depths
5) Location: Fitness Floor, LT Kid's Gym, and Movement Studio

i. LVT to Concrete:
1) Manufacturer and products:
(a) Schluter; Vinpro-U
(b) Laticrete; Transition TR1
2) Finish: Brushed chrome anodized aluminum (ACGB)

j. Rubber Floor to Concrete
1) Manufacturers: Johnsonite
2) Product: CTA-TB1-P
3) Color: TB1 Peppercorn
4) Location: Fitness Floor

k. Levelers:
1) LS-40X
(a) Manufacturer: Johnsonite
(b) Color: Black
(c) Location: Floor transitions as necessary.

B. Stair Nosing:
1. Rubber stair nosing:
a. Unless indicated otherwise on drawings, provide rubber stair nosings as follows:
b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1) Johnsonite.
2) Armstrong World Industries, Inc.
3) Roppe Corporation, USA.
4) VPI, LLC; Floor Products Division.
c. Description: Where stair treads are finished in resilient flooring, furnish matching nosings.
d. Material: To match tread material.
e. Profile and Dimensions: As indicated.
f. Colors and Patterns: As selected by Architect from full range of industry colors.
2. Wood stair nosing:
a. Where indicated on drawings, furnish wood nosings as follows:
1) Solid wood.
(a) Species and finish as indicated on drawings.

C. Resilient Expansion Covers:
1. Manufacturers and products: Subject to compliance with requirements, provide one of the following:
a. Johnsonite: CD-XX-C.
b. Armstrong World industries, Inc.
c. Roppe Corporation, USA.
d. VPI, LLC; Floor Products Division.
2. Description: Covering for expansion joints in LVT material on details.
3. Material and Color: Match floor material.

D. Aluminum Expansion Covers: Provide type as shown on details.
1. Aluminum Transitions:
a. Inpro Architectural Products 801 Series floor expansion joint cover (ADA saddle threshold).
1) Size: coordinate with size of joint.
b. Or approved equal.

2.09 FLOOR PAINT

A. Where indicated on drawings, apply paint at play surfaces:

1. Manufacturer and Product:
    a. Endura Low VOC EX-2C Topcoat Gameline Coating.
    b. Endura Prepare Thinner II.
2. Description: two component polyurethane paint and adhesion promoter.
3. 2" wide lines, color as indicated on drawings.

2.10 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Static Dissipative Tile Adhesive: 2 in. (5.08 cm) wide x 24 in. (60.96 cm) long copper ground-connection strips under the tile and wall base as recommended by the flooring manufacturer.

C. Rubber Tile Adhesives: Certified by the Manufacturer: PU 105 polyurethane adhesive or EP 55 epoxy adhesive. Refer to instruction manual of adhesives provided by rubber athletic flooring Manufacturer.

D. Floor Polish: Provide protective liquid floor polish products as recommended by manufacturer.

E. Adhesives: Water-resistant, mildew-resistant, no staining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed resilient tile and as recommended/ required by the manufacturer for warrantee acceptance or provided by resilient tile manufacturer for the type of flooring being installed.

F. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

G. VCT and Asphalt Tile Adhesives: 50 g/L.

H. Cove Base Adhesives: 50 g/L.

I. Rubber Floor Adhesives: 60 g/L.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates: Prepare according to ASTM F710.
1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
4. Moisture Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
    a. Perform anhydrous calcium chloride test, ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install floor tiles until they are same temperature as space where they are to be installed.
   1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.03 RESILIENT FLOORING INSTALLATION

A. Comply with manufacturer's written instructions for installing floor.

B. Lay out floor tiles/rolls from center marks established with principal walls, discounting minor offsets, so tiles/rolls at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half unit at perimeter.
   1. Lay tiles/rolls square with room axis.

C. Expansion Joints: Provide expansion joints as required by manufacturer.
   1. Joints to be located as indicated on drawings, or placed equidistant throughout surface.
   2. Install cover strips as specified.

D. Match floor tiles/rolls for color and pattern by selecting from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
   1. Unroll and install all rolled goods in the same direction.

E. Scribe, cut, and fit floor tiles/rolls to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

F. Extend floor tiles/rolls into toe spaces, door reveals, closets, and similar openings. Extend floor tiles/rolls to center of door openings.

G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles/rolls as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.

H. Install floor tiles/cut rolls on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in finished floor areas. Maintain overall continuity of color and pattern between pieces of material installed on covers and adjoining material. Tightly adhere edges to substrates that abut covers and to cover perimeters.

I. Adhere floor tiles/rolls to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

J. Install copper grounding strips into adhesive in strict accordance with manufacturer’s written instructions.

K. Roll flooring with a 100-pound (45.36 kilogram) roller. Refer to specific rolling instructions of the flooring manufacturer.

3.04 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates. Do not stretch resilient base during installation.

E. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

F. Preformed Corners: Install preformed corners before installing straight pieces.

G. Job-Formed Corners:

1. Outside Corners: Use straight pieces of maximum lengths possible. Form without producing discoloration (whitening) at bends.
2. Inside Corners: Use straight pieces of maximum lengths possible.

H. Mitered Corner
1. Where two base pieces meet at a corner, inside or outside, both shall be mitered.
2. Butting base materials together at corners is not acceptable.

3.05 RESILIENT MOLDING INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient accessories.

B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of carpet and resilient floor covering that would otherwise be exposed.

C. Place resilient edge strips tightly butted to flooring, and secure with adhesive recommended by the edge strip manufacturer. Install edge strips at edges of flooring that would otherwise be exposed.

D. Provide transition/reducing strips tapered to meet abutting materials.

E. Provide threshold of thickness and width as shown on the drawings.

F. Provide resilient edge strips of equal gauge to the flooring, homogeneous vinyl or rubber composition, tapered or bullnose edge, with color to match or contrast with the flooring, or as selected by the Architect from standard colors available.

3.06 FLOOR PAINT INSTALLATION

A. Comply with manufacturer's written instructions.

B. Prepare floor surfaces as indicated by manufacturer.
1. Mark off lines as indicated on drawings with solvent resistant tape.
2. Sand and clean.
3. Apply Prepare Thinner II to areas to be painted. Do not apply thinner to other areas.
4. Apply paint lines according to manufacturer's instructions.
5. Allow paint to cure according to manufacturer's instructions. Do not allow any traffic during this period.

3.07 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of floor.

B. Perform the following operations immediately after completing floor installation:
1. Remove adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Protect floor products from marring, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Floor Polish: Remove soil, visible adhesive, and surface blemishes from floor surfaces before applying liquid floor polish.
1. Apply two coats.

E. Cover floor until Substantial Completion.

END OF SECTION

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SECTION 09 65 20
RESILIENT FLOORING - SCHEDULE

RUBBER FLOOR TILE

1.01 RT-2:

A. Distributor: Hank's Specialties
B. Manufacturer: Tarkett / Johnsonite
C. Product: Triumph Sports and Multi-Function Rubber Flooring
D. Thickness: 3/8'' (10 mm)
E. Tiles: 24" x 24"
F. Colors: "LTF Custom Brown"
G. Installation: 1/2 Ashlar
H. Location: Fitness Floor, GTX, Alpha
I. Contact: Baker, Kellan kellan.baker@tarkett.com; Schaeffel, Andy Andy.Schaeffel@tarkett.com
J. URL: https://www.tarkettexchange.com/m/5a54639d98130cee/original/DS_TNA_TRIUMPH.pdf

1.02 RT-7:

A. Manufacturer: Ecore
B. Product: DbTile
C. Size: 24" x 24"
D. Thickness: 2.5"
E. Colors: Mocha Latte 2
F. Installation: Stacked
G. Location: Alpha
H. URL: https://ecoreathletic.com/products/rubber/performance/performance-dbtile

1.03 RT-7A:

A. Manufacturer: Ecore
B. Product: DbTile
C. Size: 24" x 24"
D. Thickness: 1"
E. Colors: Mocha Latte 2
F. Installation: Stacked
G. Location: Team Burn, Resistance
H. URL: https://ecoreathletic.com/products/rubber/performance/performance-dbtile

1.04 RT-8:

A. Manufacturer: Ecore
B. Product: Heritage Motivate
C. Size: 6.25" x 48" Plank
D. Thickness: 7 mm
E. Colors: Northwood 1005
F. Installation: 1/3 Offset
G. Location: Group Fitness #1, #2 and Yoga

H. URL: https://ecoreathletic.com/performance-vinyl-tile/heritage-motivate

VINYL COMPOSITION FLOOR TILE

2.01 VCT-1:

A. Manufacturer: Armstrong World Industries
B. Product: Standard Excelon Imperial Texture
C. Color: 51810 Washed Linen
D. Size: 12” x 12”
E. Thickness: 1/8”
F. URL: https://www.armstrongflooring.com/commercial/en-us/products/vinyl-composition-tile/std-excelon-imp-texture/item/51810.html

STATIC DISSIPATIVE TILE FLOORING

3.01 VCT-3:

A. Manufacturer: Static Smart
B. Static Dissipative Tile (SDT) ESD
C. Color: Rainer C6005
D. Size: 12”x12”
E. Thickness: 1/8”
F. Location: MDF Room
G. URL: https://staticsmart.com/resilient-flooring/esd-vinyl-tile/

LUXURY VINYL PLANK TILE

4.01 LVT-17A2

A. Manufacturer: Mohawk
B. Product: Life Wood
C. Color: Endurance
D. Size: 9” x 59”
E. Thickness: 5mm
F. Wear Layer: 20 mil
G. Installation: Glue-down: M-Force Enhanced Urethane
H. Location: General LVT
I. Contact: Casey Barbee email: casey_barbee@mohawkind.com
J. URL: https://www.mohawkgroup.com/detail/HardSurface/14795/182458/Better-Together-12-x-36

4.02 LVT-18:

A. Product: Better Together C0097
B. Color: 989 Argus
C. Size: 12” x 36”
D. Thickness: 5mm
E. Wear Layer: 20 mil
F. Finish: M-Force Enhanced Urethane
G. Installation: Glue-down

H. Location: Dark Border at LVT Fitness Floor
I. Contact: Tim Ranagan, tim_ranagan@mohawkind.com, 612.859.8982
J. URL: https://www.mohawkgroup.com/detail/HardSurface/14795/182463/Better-Together-12-x-36

4.03 LVT-19:

A. Manufacturer: Mohawk
B. Product: Better Together C0097
C. Color: 766 Argus
D. Size: 8" x 48”
E. Thickness: 5mm
F. Wear Layer: 20 mil
G. Finish: M-Force Enhanced Urethane
H. Installation: Glue-down
I. Location: LT Work
J. Contact: Tim Ranagan, tim_ranagan@mohawkind.com, 612.859.8982
K. URL: https://www.mohawkgroup.com/detail/HardSurface/14795/182463/Better-Together-12-x-36

4.04 LVT-22:

A. Manufacturer: Milliken
B. Product: Powergrid
C. Color: PWG15 Conduit
D. Size: 36” x 36”
E. Thickness: 5mm
F. Wear Layer: .7 mil
G. Finish: Reinforced Polyurethane Coating
H. Installation: Loose lay with perimeter glue
I. Location: LT Recovery, Mobility and Waiting areas
J. Contact: Cari Kapsner, cari.kapsner@milliken.com, 612.750.8585
K. URL: https://floors.milliken.com/product-catalog/en-us/design-details?region=Americas&market=Contract&catalog=Products&ColorId=31996

4.05 LVT-23A:

A. Manufacturer: Mannington
B. Product: Upward 20
C. Color: Sugared Oak UPW20-1220
D. LTF SKU: #585424
E. Size: 6" x 36"
F. Thickness: 2.5mm
G. Wear Layer: 20 mil
H. Profile: Unbeveled
I. Installation: Glue-down in random pattern
J. Location: Infant, Toddler, Activity Studio, Language Arts
K. Contact: Lisa Fahey lisa.fahey@mannington.com 612-759-5472

L. URL: https://www.manningtoncommercial.com/products/hard-surface/lvt/upward-20-wood/

RESILIENT ROLL/SHEET FLOORING

5.01 RSF-1A

A. Manufacturer: Ecore
B. Product: Performance Beast
C. Size: 48" x 25' roll
D. Thickness: 10.5 mm
E. Color: ES43A Mocha Latte 2
F. Installation: See specs
G. Location: See drawings.
H. Contact: Dan Anderson dmanderson@ecoreintl.com
I. URL: https://ecoreintl.com/products/rubber/fit-collection

5.02 RSF-1B

A. Manufacturer: Ecore
B. Product: Custom Fit Collection
C. Size: 51" x 25' roll
D. Thickness: 3.2 mm
E. Color: ES43A Mocha Latte 2
F. Installation: See specs
G. Location: See drawings.
H. Contact: Dan Anderson dmanderson@ecoreintl.com
I. URL: https://ecoreintl.com/products/rubber/fit-collection

5.03 RSF-2:

A. Manufacturer: Ecore
B. Product: Performance Beast
C. Size: 48" x 25' Roll
D. Thickness: 10.5 mm
E. Color: ES506 Dark Taupe
F. Installation: Sheet
G. Location: Fitness Floor
H. Contact: Dan Anderson dmanderson@ecoreintl.com
I. URL: https://ecoreathletic.com/products/rubber/performance/performance-beast

5.04 RSF-3:

A. Manufacturer: Ecore
B. Product: Baller Motivate Class 1
C. Size: 70" x 65' Roll
D. Thickness: 7 mm
E. Color: Spike
F. Installation: Sheet

G. Location: LTKA Gym
H. Contact: Dan Anderson dmanderson@ecoreintl.com
I. URL: https://ecoreathletic.com/products/vinyl/sheet-vinyl/baller/baller-motivate-class-i

5.05 RSF-4:

A. Manufacturer: Ecore
B. Product: Performance Rally
C. Size: 48" x 50' Roll
D. Thickness: 14.5 mm
E. Color: ES43A Mocha Latte 2
F. Installation: Sheet
G. Location: LT Kid's Movement
H. Contact: Dan Anderson dmanderson@ecoreintl.com
I. URL: https://ecoreathletic.com/products/rubber/performance/performance-rally

VINYL COMPOSITION FLOOR TILE ACCESSORIES

6.01 RESILIENT BASE

A. RB-3:
   1. Color: Black
   2. Size: 4” cove base
   3. Location: Back of House at drywall walls only – Install at Drywall Only. Do not apply to CMU.
B. RB-8
   1. Color: Black
   2. Size: 4” straight base
   3. Location: Alpha Training; at artificial turf
C. RB-9
   1. Manufacturer: Johnsonite
   2. Product Profile: MW-66-F- Reveal
   3. Color: 66 Either Ore
   4. Size: 4.25” Wall Base
   5. Thickness: 0.25"
   6. Location: Reception, Offices, Spa waiting, Spa treatment, Fitness floor, Cycle, Mothers Room, LT Recovery
   7. URL: https://commercial.tarkett.com/en_US/collection-C001527-scs-color-chips/66-either-ore

6.02 VINYL RESILIENT BASE

A. VB-2:
   1. Manufacturer: Johnsonite
   2. Product: CB-XX
   3. Color: 66 Either Ore
   4. Size: four (4”) inch cove base
   5. Location: Kids Academy
   6. URL: https://commercial.tarkett.com/en_US/collection-C001527-scs-color-chips/66-either-ore
B. VB-3:
   1. Manufacturer: Johnsonite
   2. Product: MW-XX-J
   3. Color: 47 Brown
   4. Size: Four (4”) inch millwork wall base

5. Location: Spa Waiting
6. URL: https://commercial.tarkett.com/en_US/collection-C001527-scs-color-chips/47-brown

END OF SECTION

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SECTION 09 65 66
RESILIENT ATHLETIC SPORTS SURFACE (RACQUET SPORTS)

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Provide labor, materials, tools and equipment to perform work and services of resilient coatings over concrete for the following:
   1. Indoor Tennis. [CPS-1] – **Not Used**
   2. Outdoor Tennis. [CPS-2] – **Not Used**
   3. Pickleball: New wood substrate. [CPS-3] – **Not Used**
   4. Pickleball: Concrete substrate. [CPS-4] – **Not Used**
   5. Exterior [CPS-5}
   6. Interior [CPS-6]

B. Work not included:
   1. Sub-base materials.
   2. Base materials.
      a. Concrete: Specified in Division 3.
      b. Asphalt: By Civil.

1.02 RELATED SECTIONS

A. Section 01 33 00 - Submittal Procedures.

B. Section 01 40 00 - Quality Requirements.

C. Section 01 60 00 - Product Requirements.

D. Section 01 92 00 - Facility Operation and Maintenance.

E. Section 03 30 00 - Cast-in-Place Concrete.

F. Section 03 38 00 - Post-Tensioned Concrete.

G. Section 06 10 00 - Rough Carpentry

H. Section 09 05 61 - Common Work Results for Flooring Preparation.

I. Section 09 65 19 - Resilient Flooring.

1.03 REFERENCES

A. BS EN ISO 6272-1: Paints and varnishes. Rapid-deformation (impact resistance) tests. Falling-weight test, large-area indenter: 2011

1.04 SUBMITTALS

A. Submit under provisions of Section 01 30 00.

B. Product Data: Manufacturers descriptive literature for specified cushioned athletic resilient sports coatings.

C. Shop Drawings, Dimensioned plans indicating layout of athletic resilient sports coatings.

D. Quality Assurance Submittals: Manufacturers printed installation instructions. Proprietary techniques are accepted.

E. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.
   3. See Sections 01 33 00 and 01 60 00.

F. Closeout Submittals:
   1. Operation and Maintenance Data: Submit O&M manuals according to the requirements of Section 01 92 00 - Facility Operation and Maintenance. Manufacturer’s recommendations for cleaning and maintaining coatings.

2. Warranty documents specified in Warranty Article of Part 1 of this section.

1.05 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Qualifications:
   1. Manufacturer: Minimum ten (10) years documented experience producing athletic resilient sports coatings similar to those specified in this section.
      a. Minimum ISO 9001 certification for design, manufacture and distribution.
      b. Minimum ten (10) years documented use of cushioned athletic resilient sports surfaces by major sporting venues worldwide.
   2. Installer: Minimum five (5) years documented experience installing athletic resilient sports coatings similar to those specified in this section.

1.06 DELIVERY, STORAGE & HANDLING

A. Acceptance at Site: Ensure materials arrive at the site in unopened and undamaged containers. Do not allow unacceptable materials to be used.

B. Storage: Keep material from freezing, store on pallets in a cool place. Avoid exposure to Sun.

C. Record batch numbers from delivered material and enter into Warranty registration form.

1.07 PROJECT CONDITIONS

A. Existing conditions: Examine areas where materials are to be installed, particularly the sub-base, drainage, compaction and levelness.

B. Ensure area to be surfaced is to be clear of any construction traffic, pedestrian traffic and any obstructions during application of Resilient Sports Surface.

C. Provide protection to adjacent surfaces to avoid spills.

D. Approximately one 10 yard dumpster or trash container per 7,000 sq. ft. near the area of installation and shall be within easy access.

E. Electricity (110V) and a supply of drinkable water shall be on hand during entire installation process.

F. Indoor Installation with wood components requires the following conditioning period:
   1. Conditioning period begins not less than seven days before wood flooring installation, and is continuous through installation.
      a. Environmental Conditioning: Maintain an ambient temperature between 65 and 75 deg F (18 and 24 deg C) and relative humidity planned for building occupants in spaces to receive wood flooring during the conditioning period.
      b. Wood SubFlooring Conditioning: Move wood subflooring into spaces where it will be installed, no later than the beginning of the conditioning period.
         1) Do not install flooring until it adjusts to relative humidity of, and is at same temperature as, space where it is to be installed.
         2) Open sealed packages to allow wood flooring to acclimatize immediately on moving flooring into spaces in which it will be installed.
   2. Humidity Control: relative humidity between thirty-five (35%) percent and fifty-five (55%) percent.
   3. After conditioning period, maintain relative humidity and ambient temperature planned for building occupants.

1.08 WARRANTY

A. Manufacturer’s Warranty: Manufacturer’s standard warranty against defects in products.

B. Installers Warranty: Installers standard warranty against defective workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturers:
   1. California Sports Surfaces, 150 Dascomb Rd. Andover, MA 01810 (978) 623.9980.

2. Laykold by Advanced Polymer Technology Corp. 109 Conica Lane PO Box 160, Harmony PA 16037.
3. Or approved equal.

2.02 [CPS-5] EXTERIOR COURT SURFACE

A. Characteristics: Hard court system:
   1. Substrate (by others):
      a. Concrete
      b. Asphalt.
   2. Seamless liquid installation.

B. Basis of Design Product:
   1. Laykold: Masters Color.

C. Acceptable Alternates
   1. California Sport Surfaces: Plexipave: Plexi I.W. Hardcourt System.

D. Surfacing:
   1. Composition: Acrylic resin blended with sand.
      a. Primer/ Leveller Layer by Manufacturer.
      b. Surface by Manufacturer:
         1) Apply to thickness according to Manufacturer's written instructions.
      c. Line Paint: Acylic latex by Manufacturer.
      d. Sand: Local sands are not acceptable. Provide sand as approved by the Manufacturer.
   2. UV stable.
   3. Slip resistance: Co-efficient of static friction U=1.
   4. Size and configuration: See Drawings.
   5. Accessories:
      a. Patching Mix: By Manufacturer.
      b. Crack Filler: By Manufacturer.
   6. Linemaking: non-slip acrylic linemarking.
   7. Colors:
      a. Boundary Lines: White.
      b. Tennis:
         1) In Bounds: LM Pro Blue or approved match
         2) Out of Bounds: LM Grass Green or approved match.
      c. Pickleball:
         1) In Bounds: LM Pro Blue or approved match
         2) Out of Bounds: LM Grass Green or approved match.
         3) Kitchen: LM Dark Gray or approved match.

2.03 [CPS-6] INTERIOR COURT SURFACE

A. Characteristics: Cushioned court surface.
   1. Substrate (by others):
      a. Concrete
   2. Seamless liquid installation.

B. Basis of Design Product:
   1. Laykold: Masters 5

C. Acceptable Alternates
   1. California Sport Surfaces: Rebound Ace Club 5 Mat System

D. Surfacing:
   1. Composition:
      a. Adhesive layer by Manufacturer.
      b. Shock pad (5mm) by Manufacturer.
      c. Sealer by Manufacturer.

d. Reinforcing Mesh by Manufacturer.
e. Bond Coat, by Manufacturer.
1) Latex emulsion primer.
f. Top Coat by Manufacturer.
1) Sand filled 100% acrylic emulsion.
2. 12% Force reduction, Min.
3. Slip resistance: Co-efficient of static friction U=1.
4. UV stable.
5. Size and configuration: See Drawings.
6. Accessories: See below.
7. Linemaking: non-slip acrylic linemarking.
8. Colors:
a. Boundary Lines: White.
b. Tennis:
1) In Bounds: LM Pro Blue or approved match.
2) Out of Bounds: LM Modern Green or approved match.
c. Pickleball:
1) In Bounds: LM Pro Blue or approved match.
2) Out of Bounds: LM Modern Green or approved match.
3) Kitchen: LM Dark Gray or approved match.

2.04 ACCESSORIES

A. Floor Transitions: Provide type as shown on details.
1. Aluminum Transitions:
a. Inpro Architectural Products 801 Series floor expansion joint cover (ADA saddle threshold)
1) Size: coordinate with size of joint.
b. Or approved equal.
2. Resilient Transitions: Subject to compliance with requirements, provide products by one of the following:
a. Johnsonite. (Basis of Design)
b. Armstrong World Industries, Inc.
c. Roppe Corporation, USA.
d. VPI, LLC; Floor Products Division.
3. Description: Transition strips between flooring materials.
4. Material: Rubber.
5. Profile and Dimensions: As indicated.
6. Transition Type:
a. See other flooring type and details.

PART 3 EXECUTION

3.01 EXAMINATION

A. Check concrete surfaces for spalling, depressions, cracking and surface irregularities, and adhesion of any existing acrylic surfaces or residues.

B. Installers Examination:
1. Installer shall examine conditions under which construction activities of this section are to be performed, then submit written notification if such conditions are unacceptable.
2. Transmit two copies of installers report to architect or owner.
3. Beginning construction activities of this section before unacceptable conditions have been corrected is prohibited.
4. Beginning construction activities of this section indicates installer’s acceptance of conditions.

3.02 PREPARATION

A. Concrete Substrate:

1. Sub-base, by others, Part. 1.1c-2a - To be trimmed smooth and compacted to a field dry density of not less than 95%.
2. Moisture/Vapor Barrier, by others, Part. 1.1c-2a – Moisture/vapor barrier, consisting of polyethylene (6 mil. Minimum thickness) should be installed prior to installation of any steel and/or cables. Overlap polyethylene sheets at least 6” and tape joints. Once in place no vehicular traffic should be allowed on the moisture/vapor barrier nor any other object, which could puncture the barrier or otherwise compromise the integrity of the surface.
3. Surface Accuracy, by others, Part 1.1c-2a - Base concrete surface to be laid to an accuracy of a maximum deviation of 1/8 inch beneath a 10-foot straight edge when measured in any direction.
4. Curing - New concrete is to cure for 30 days prior to application of any athletic resilient sport coating materials.
5. Cleaning/Acid Etching - Ensure the surface is clean and free from dirt, dust, grease and foreign materials to receive cushioned sports system. When acid etching, follow manufacturer’s instructions and wash with copious amounts of water. Use a stiff bristle broom.
6. Pressure washing - Pressure wash entire surface to remove any residues.
7. Scraping - Scrape surface then broom and blow surface clean.
8. Leveling - Flood courts with water to test for ponding, any areas still retaining water 1/8” deep after 20 minutes shall be leveled with Flowing Topping and Repair Mortar, as specified in Section 03 30 00.
9. Cracking - Vee out any cracks and fill with Polymer Patching Mortar, as specified in Section 03 30 00.

3.03 INSTALLATION

A. Install athletic resilient sports surfaces in accordance with shop drawings and manufacturers written instructions.

3.04 PROTECTION

A. Prevent any sort of traffic over flooring until the manufacturer's required curing time elapses.

B. Protect installed products of this section from damage to function or finish by subsequent construction activities.

C. Repair minor damage to finishes in accordance with manufacturer’s recommendations.

3.05 DEFECTIVE WORK OR MATERIALS

A. Remove from the work site and replace material, which has deteriorated, or become contaminated in any way, prior to its application, at no additional expense to Owner. Dispose of waste materials legally, off site.

END OF SECTION

SECTION 09 67 23
RESINOUS FLOORING

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes resinous, epoxy flooring.

1.02 RELATED SECTIONS

A. Section 01 33 00 - Submittal Procedures.

B. Section 01 40 00 - Quality Requirements.

C. Section 01 60 00 - Product Requirements.

D. Section 01 92 00 - Facility Operation and Maintenance.

E. Section 03 30 00 - Cast in Place Concrete.

F. Section 09 05 61 - Common Work Results for Flooring Preparation.

G. Section 09 30 00 - Tile.

H. Section 09 65 19 - Resilient Flooring.

1.03 REFERENCE STANDARDS

A. ASTM C307 - Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacings; 2018.

B. ASTM C579 - Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes; 2023.

C. ASTM C580 - Standard Test Method for Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes; 2018 (Reapproved 2023).

D. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness; 2015 (Reapproved 2021).

E. ASTM D2369 - Standard Test Method for Volatile Content of Coatings; 2020.

F. ASTM D2794 - Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact); 1993 (Reapproved 2024).

G. ASTM D4060 - Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser; 2019.

H. ASTM E413 - Classification for Rating Sound Insulation; 2022.

I. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2023.

J. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2023.

K. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.

L. ICRI 310.2R - Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair.

1.04 SUBMITTALS

A. Product Data: For each type of product indicated. Include manufacturer's technical data, application instructions, and recommendations for each resinous flooring component required.

B. Samples for Verification: For each resinous flooring system required, 5 inches (150 mm) square, applied to a rigid backing.

C. Product Schedule: Use resinous flooring designations indicated in Part 2 and room designations indicated on Drawings in product schedule.

D. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.

E. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.
   3. See Sections 01 33 00 and 01 60 00.

F. Operation and Maintenance Data: Submit O&M manuals according to the requirements of Section 01 92 00 - Facility Operation and Maintenance.

1.05 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. No request for substitution shall be considered that would change the generic type of floor system specified (i.e. epoxy mortar based system with decorative quartz topping). Equivalent materials of other manufactures may be substituted only on approval of Architect or Engineer. See 01 33 00 Submittal Procedures and 01 60 00 Product requirements.

C. Installer Qualifications:
   1. Engage an installer who is certified in writing by resinous flooring manufacturer as qualified to apply resinous flooring systems indicated.
   2. Contractor shall have completed at least 10 projects of similar size and complexity.

D. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, through one source from a single manufacturer, with not less than ten years of successful experience in manufacturing and installing principal materials described in this section. Provide secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from source recommended by manufacturer of primary materials.

E. Manufacturer Field Technical Service Representatives: Resinous flooring manufacture shall retain the services of Field Technical Service Representatives who are trained specifically on installing the system to be used on the project.
   1. Field Technical Services Representatives shall be employed by the system manufacture to assist in the quality assurance and quality control process of the installation and shall be available to perform field problem solving issues with the installer.

F. Pre-installation Conference:
   1. General contractor shall arrange a meeting not less than thirty days prior to starting work.
   2. Attendance:
      a. General Contractor
      b. Architect/Owner's Representative.
      c. Manufacturer/Installer's Representative.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.

B. Store materials to prevent deterioration from moisture, heat, cold, direct sunlight, or other detrimental effects. Store material per product data sheet.

C. All materials used shall be factory pre-weighed and pre-packaged in single, easy to manage batches to eliminate on site mixing errors. No on site weighing or volumetric measurements allowed.

1.07 PROJECT CONDITIONS

A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.
   1. Maintain material and substrate temperature between 65 and 85 deg F (18 and 30 deg C) during resinous flooring application and for not less than 24 hours after application.

B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.

C. Close spaces to traffic during resinous flooring application and for not less than 24 hours after application, unless manufacturer recommends a longer period.

D. Concrete substrate shall be properly cured. A vapor barrier must be present for concrete subfloors on or below grade. Otherwise, an osmotic pressure resistant grout must be installed prior to the resinous flooring

1.08 WARRANTY

A. Manufacturer shall furnish a single, written warranty covering both material and workmanship for a period of (1) full years from date of installation, or provide a joint and several warranty signed on a single document by material manufacturer and applicator jointly and severally warranting the materials and workmanship for a period of (1) full year from date of installation. A sample warranty letter must be included with bid package or bid may be disqualified.

PART 2 PRODUCTS

2.01 RESINOUS FLOORING

A. Resinous Flooring with Epoxy base and Quartz broadcast. (**RF-1**)
   1. Acceptable Manufactures:
      a. Stonhard.
      b. Tnemec.
      c. Neogard.
      d. Or approved equal
   2. Products: Subject to compliance with requirements:
      a. Stonhard, Inc.; Stonshield HRI®.
      b. Tnemec; Deco-Tread N222 Quartz System
      c. Neogard; NeoQuartz HD
      d. Or approved equal.

B. System Characteristics:
   1. Color and Pattern:
      a. Basis of Design: Stonshield Frappe
      b. Or approved equal.
   2. Wearing Surface: Standard or medium.
   3. Integral Cove Base: 6”.
   4. Overall System Thickness: nominal 1/8” - 3/16”

C. System Components: Manufacturer's standard components that are compatible with each other and as follows:
   1. Primer:
      a. Manufacturer's standard primer as recommended for the substrate.
      b. Resin: Epoxy.
      c. Formulation Description: (2) two component, 100 percent solids.
      d. Application Method: Squeegee and roller.
      e. Number of Coats: (1) one.
   2. Mortar Base:
      a. Manufacturer's standard.
      b. Resin: Epoxy.
      c. Formulation Description: (3) three component, 100 percent solids.
      d. Application Method: Metal Trowel.
         1) Thickness of Coats: nominal 1/8” (inch).
         2) Number of Coats: One.
      e. Aggregates: Pigmented Blended aggregate.
   3. Undercoat:
      a. Manufacturer's standard.

b. Resin: Epoxy
c. Formulation Description: (2) two-component, 100% solids, UV Stable.
d. Type: Clear.
e. Finish: Gloss.
f. Number of Coats: one.

4. Broadcast Media:
   a. Material Basis: Quartz aggregate
   b. Type: Pigmented.
   c. Finish: Standard.
   d. Number of Coats: One.
   e. Pattern: Tweed.
5. Sealer:
   a. Manufacturer's standard.
   b. Resin: Epoxy.
   c. Formulation Description: (2) two-component, 100% solids, UV Stable.
   d. Type: Clear.
   e. Finish: Gloss.
   f. Number of Coats: one.
   g. Texture level: Standard or medium.

D. System Physical Properties: Provide resinous flooring system with the following minimum physical property requirements when tested according to test methods indicated:
1. Compressive Strength: 10,000 psi after 7 days per ASTM C579
2. Tensile Strength: 2,000 psi per ASTM C307
3. Flexural Strength: 4,300 psi per ASTM C580
4. Flexural Modulus of Elasticity: 2.0 x 106 psi per ASTM C580
5. Hardness: 85 to 90 per ASTM D2240, Shore D
6. Impact Resistance: > 160 in./lbs. per ASTM D2794
7. Abrasion Resistance: 0.06 gm max. weight loss per ASTM D4060, CS-17
8. Flammability: Class 1 per ASTM E648.
9. Thermal Coefficient of Linear Expansion: 1.3 x 10-5 in./in. oF
10. Water Absorption: 0.1% per ASTM E413
11. VOC Content per ASTM D2369:
    a. Completed Assembly complies with requirements of USGBC LEED-NC
12. Cure Rate @ 77oF/25oC:12 hours foot traffic, 24 hours normal operations.

2.02 ACCESSORY MATERIALS

A. Patching, Leveling and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated.

B. Joint Sealant: Type recommended or produced by resinous flooring manufacturer for type of service and joint condition indicated. Allowances should be included for Stonflex MP7 joint fill material.

PART 3 EXECUTION

3.01 PREPARATION

A. General: Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean and dry substrate for resinous flooring application.

B. Concrete Substrates: Prepare concrete substrates with Topping and Repair material as specified in Section 03 30 00 - Cast in Place Concrete.
1. Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.
2. Mechanically prepare substrates as follows:

a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup, or Diamond Grind with dust free system.

3. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written recommendations.
4. Verify that concrete substrates meet the following requirements.
   a. Perform in situ probe test, ASTM F2170. Proceed with application only after substrates do not exceed a maximum potential equilibrium relative humidity of 85 percent.
   b. Perform anhydrous calcium chloride test, ASTM F1869. Proceed with application only after substrates have maximum moisture-vapor-emission rate of 6 lb of water/1000 sq. ft. of slab in 24 hours.
   c. Perform additional moisture tests recommended by manufacturer. Proceed with application only after substrates pass testing.

C. Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.

D. Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written recommendations. Allowances should be included for Stonflex MP7 joint fill material, and CT5 concrete crack treatment.

3.02 APPLICATION

A. General: Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.
   1. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
   2. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.
   3. At substrate expansion and isolation joints, provide joint in resinous flooring to comply with resinous flooring manufacturer's written recommendations.
      a. Apply joint sealant to comply with manufacturer's written recommendations.

B. Integral Cove Base: Stonshield cove mortar, apply cove base mix to wall surfaces before applying flooring. Apply according to manufacturer's written instructions and details including those for taping, mixing, priming, troweling, sanding, of cove base. Round internal and external corners.
   1. Integral Cove Base: 4 inches high, minimum.

C. Apply primer where required by resinous system, over prepared substrate at manufacturer's recommended spreading rate.

D. Apply metal trowel single mortar coat in thickness indicated for flooring system into wet primer. Hand or power trowel and grout to fill voids. When cured, sand to remove trowel marks and roughness.

E. Undercoat: Remove any surface irregularities by lightly abrading and vacuuming the floor surface. Mix and apply undercoat with strict adherence to manufacturer's installation procedures and coverage rates.

F. Broadcast: Immediately broadcast quartz silica aggregate into the undercoat using manufacturer's specially designed spray caster. Strict adherence to manufacturer's installation procedures and coverage rates is imperative.

G. Apply topcoat(s) in number of coats indicated for flooring system and at spreading rates recommended in writing by manufacturer.

3.03 TERMINATIONS

A. Chase edges to “lock” the flooring system into the concrete substrate along lines of termination.

B. Penetration Treatment: Lap and seal resinous system onto the perimeter of the penetrating item by bridging over compatible elastomer at the interface to compensate for possible movement.

C. Trenches: Continue flooring system into trenches to maintain monolithic protection. Treat cold joints to assure bridging of potential cracks.

D. Treat floor drains by chasing the flooring system to lock in place at point of termination.

3.04 JOINTS AND CRACKS

A. Treat control joints to bridge potential cracks and to maintain monolithic protection.

B. Treat cold joints and construction joints and maintain monolithic protection on horizontal and vertical surfaces as well as horizontal and vertical interfaces.

C. Install backer rod and compatible sealant at vertical and horizontal control joints after coating installation is completed. Provide sealant type recommended by manufacturer for traffic conditions and chemical exposures to be encountered.

3.05 FIELD QUALITY CONTROL

A. Material Sampling: Owner may at any time and any numbers of times during resinous flooring application require material samples for testing for compliance with requirements.
   1. Owner will engage an independent testing agency to take samples of materials being used. Material samples will be taken, identified, sealed, and certified in presence of Contractor.
   2. Testing agency will test samples for compliance with requirements, using applicable referenced testing procedures or, if not referenced, using testing procedures listed in manufacturer's product data.
   3. If test results show applied materials do not comply with specified requirements, pay for testing, remove noncomplying materials, prepare surfaces coated with unacceptable materials, and reapply flooring materials to comply with requirements.

3.06 CLEANING, PROTECTING, AND CURING

A. Cure resinous flooring materials in compliance with manufacturer's directions, taking care to prevent contamination during stages of application and prior to completion of curing process. Close area of application for a minimum of 24 hours.

B. Protect resinous flooring materials from damage and wear during construction operation. Where temporary covering is required for this purpose, comply with manufacturer's recommendations for protective materials and method of application. General Contractor is responsible for protection and cleaning of surfaces after final coats.

C. Cleaning: Remove temporary covering and clean resinous flooring just prior to final inspection. Use cleaning materials and procedures recommended by resinous flooring manufacturer. General contractor is responsible for cleaning prior to inspection.

END OF SECTION

SECTION 09 68 13
TILE CARPETING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Modular carpet tile.

1.02 RELATED SECTIONS

A. Section 01 33 00 - Submittal Procedures.

B. Section 01 40 00 - Quality Requirements.

C. Section 01 60 00 - Product Requirements.

D. Section 03 30 00 - Cast-in-Place Concrete.

E. Section 09 05 61 - Common Work Results for Flooring Preparation.

F. Section 09 30 00 - Tile.

G. Section 09 65 66 - Resilient Flooring.

H. Section 09 68 14 - Tile Carpeting Schedule.

1.03 REFERENCE STANDARDS

A. ASTM D5116 - Standard Guide for Small-Scale Environmental Chamber Determinations of Organic Emissions from Indoor Materials/Products; Current Edition.

B. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2023.

C. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2022.

D. CRI 104 - Standard for Installation of Commercial Carpet; 2015.

E. GBC, Section 5.504.4 – Carpet Systems. All carpet installed in the building shall meet the testing and product requirements of one of the following:
   1. Carpet and Rug Institute’s Green Label Plus Program.
      a. California Department of Public Health Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers, Version 1.1, February 2010 (also known as Specification 01350).
      b. NSF/ANSI 140 at the Gold level or higher.
      c. Scientific Certifications Systems Sustainable Choice.

1.04 SUBMITTALS

A. Product Data: For each type of product indicated. Include manufacturer's written data on physical characteristics, durability, and fade resistance. Include installation recommendations for each type of substrate.

B. Samples for Verification: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
   1. Carpet Tile: Full-size Sample.
   2. Exposed Edge, Transition, and other Accessory Stripping: 12-inch- (300-mm-) long Samples.

C. Product Schedule: For carpet tile. Use same designations indicated on Drawings.

D. Qualification Data: For Installer.

E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency.

F. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.

2. Submit inventory to Owner within 5 days of delivery of materials.
3. See Sections 01 33 00 and 01 60 00.

G. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:
1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

H. Warranty: Special warranty specified in this Section.

1.05 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Installer Qualifications: An experienced installer who is certified by the Floor Covering Installation Board or who can demonstrate compliance with its certification program requirements.

C. Fire-Test-Response Characteristics: Provide products with the critical radiant flux classification indicated in Part 2, as determined by testing identical products per ASTM E648 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Comply with CRI 104, Section 5, "Storage and Handling."

1.07 PROJECT CONDITIONS

A. Comply with CRI 104, Section 7.2, "Site Conditions; Temperature and Humidity" and Section 7.12, "Ventilation."

B. Environmental Limitations: Do not install carpet tiles until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.

D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.08 WARRANTY

A. Special Warranty for Carpet Tiles: Manufacturer's standard form in which manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
2. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, loss of tuft bind strength, dimensional stability, excess static discharge, and delamination.
3. Warranty Period: 10 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 CARPET TILE

A. See Attached Schedule.

2.02 CARPET BASE

A. See Attached Schedule.

2.03 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.

B. Adhesives: Stix 2400 by XL Brands – Zero VOC, 4 gallon Pail, water-based, pressure sensitive adhesive as recommended by carpet tile manufacturer for releasable installation.

C. Adhesives: Water-resistant, mildew-resistant, no staining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet and as recommended/ required by the manufacturer for warrantee acceptance or provided by carpet tile manufacturer for the type of carpet being installed.

D. VOC Limits: Provide adhesives that comply with the following limits for VOC content when tested according to ASTM D5116:
   1. Total VOCs: 50g/L.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Examine carpet tile for type, color, pattern, and potential defects.

B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F710 and the following:
   1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet tile manufacturer.
   2. Subfloor finishes comply with requirements specified in Division 3 Section "Cast-in-Place Concrete" for slabs receiving carpet tile.
   3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. General: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch (3 mm) wide or wider and protrusions more than 1/32 inch (0.8 mm), unless more stringent requirements are required by manufacturer's written instructions.

C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.

D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.03 INSTALLATION

A. General: Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.

B. Installation Method: As recommended in writing by carpet tile manufacturer.

C. Follow standard installation instructions, including but not limited to pre-installation moisture and alkalinity testing of the concrete, removal of existing adhesive or other coatings (create a clean, smooth floor surface), and encapsulation of any residue left from this removal. Encapsulation should be completed using TriSeal or similar product specifically designed for encapsulation of adhesive residue. Skim coating using a Portland based cement compound may also be an option to create a clean surface prior to the carpet installation.

D. The following exceptions should be included as part of the installation process.
   1. Installation should be completed using a full spread of application of XL Brands Dyna-Stix MOD adhesive making sure to install carpet tiles within 15 minutes of adhesive application to increase bond strength. Adhesive should be applied using a 1/16” x 1/32” x 1/32” U notched trowel with an application rate not to exceed 30 yards per gallon.

E. Maintain dye lot integrity. Do not mix dye lots in the same area.

F. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.

G. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

H. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.

I. Install pattern parallel to walls and borders.

3.04 CLEANING AND PROTECTION

A. Perform the following operations immediately after installing carpet tile:
   1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
   2. Remove yarns that protrude from carpet tile surface.
   3. Vacuum carpet tile using commercial machine with face-beater element.

B. Protect installed carpet tile to comply with CRI 104, Section 16, "Protection of Indoor Installations."

C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION

SECTION 09 68 14
TILE CARPETING SCHEDULE

CARPET TILE

1.01 CPT-1

A. Manufacturer: Mannington Commercial
B. Pattern: Arroyo
C. Color: Mesa 84167
D. Size: 12” x 48”
E. Installation: 3-step Vertical Ashlar
F. Location: Reception and Activities Desk
G. URL: https://www.manningtoncommercial.com/products/carpet/modular/arroyo/?color=ec3c1f72-99d4-4c2f-99f8-b8ca50e76b5b

1.02 CPT-2

A. Manufacturer: Bentley
B. Pattern: Redacted 8RF23
C. Color: Anecdote 801531
D. Size: 18” x 36”
E. Installation: Ashlar
F. Location: Spa Waiting vestibule.
G. URL: https://www.bentleymills.com/product/redacted/

1.03 CPT-5

A. Manufacturer: Bentley
B. Pattern: Wanderlust
C. Color: Urban Escape 400336
D. Size: 36” x 36” *Custom
E. Installation: Ashlar
F. Location: Elevated Kids Academy
G. Contact: Michelle Anderson, michellek.anderson@bentleymills.com (612)400-5226
H. URL: https://www.bentleymills.com/product/wanderlust/

1.04 CPT-7

A. Manufacturer: Bolon
B. Pattern: BKB -Sisal
C. Color: Plain Beige
D. Location: LT Work - Conference, Lounge Rooms
E. URL: https://www.bolon.com/en/products/rugs/bkb/sisal-plain-beige

1.05 CPT-8

A. Manufacturer: Interface
B. Collection: World Woven
C. Pattern: WW860
D. Product #: 128190AK00
E. Color: 105358 Sisal Tweed

F. Size: 25cm x 1m (9.9” x 40”)

G. Installation: Ashlar

H. Location: LT Work – Offices, Quiet Rooms

I. URL: https://www.interface.com/US/en-US/detail/ww860-natural-tweed-8109006999G17S001#partNumber=8109008999G17S001&page=specifications&size=7S&configuration=15&installation=us_openoffice

1.06 CPT-9

A. Manufacturer: Bentley

B. Pattern: Wanderlust 4WNT5

C. Color: Urban Escape 400336

D. Size: 18" x 36"

E. Installation: Ashlar

F. Location: Kids Academy

G. Backing: Affirma Hardback

1.07 CPT-10

A. Manufacturer: Tarkett

B. Collection: Plexus Color IV

C. Reference #: 601053064

D. Color: 02875 Andale

E. Size: 24" x 24"

F. Installation: Ashlar

G. Location: LTKA Check-in

END OF SECTION

SECTION 09 72 00
WALL COVERINGS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Acoustical wall covering.
   2. Vinyl wall covering.
      a. Vinyl wall covering with perforations at all exterior walls with vapor barrier.

1.02 RELATED SECTIONS

A. Section 01 33 00 - Submittal Procedures.

B. Section 01 40 00 - Quality Requirements.

C. Section 01 60 00 - Product Requirements.

D. Section 01 92 00 - Facility Operation and Maintenance.

E. Section 09 21 16 - Gypsum Board Assemblies.

F. Section 09 72 00 - Wall Coverings Schedules.

G. Section 09 74 16 - Flexible Wood Veneer Wall Covering.

H. Section 09 75 00 - Interior Stone.

I. Section 09 84 14 - Acoustic Stretched-Fabric Wall Systems.

J. Section 09 84 30 - Sound Absorbing Wall and Ceiling Units.

K. Section 09 91 00 - Painting.

1.03 REFERENCE STANDARDS

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; Current Edition.

B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

C. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2023.

D. ASTM F793/F793M - Standard Classification of Wall Coverings by Use Characteristics; 2020.

E. W-101 WA - WA QUALITY STANDARD FOR POLYMER COATED FABRIC WALLCOVERING; Current edition.

1.04 SUBMITTALS

A. Product Data: For each type of product indicated. Include data on physical characteristics, durability, fade resistance, and flame-resistance characteristics.

B. Samples for Verification: Full width by 36-inch- (914-mm-) long section of wall covering.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for wall covering.

D. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.
   3. See Sections 01 33 00 and 01 60 00.

E. Operation and Maintenance Data: Submit O&M manuals according to the requirements of Section 01 92 00 - Facility Operation and Maintenance.

1.05 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Fire-Test-Response Characteristics: As determined by testing identical wall coverings applied with identical adhesives to substrates according to test method indicated below by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Surface-Burning Characteristics: As follows, per ASTM E84:
      a. Flame-Spread Index: 25 or less.
      b. Smoke-Developed Index: 50 or less.

1.06 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install wall coverings until spaces are enclosed and weathertight, wet Work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

B. Lighting: Do not install wall covering until a permanent level of lighting is provided on the surfaces to receive wall covering.

C. Ventilation: Provide continuous ventilation during installation and for not less than the time recommended by wall-covering manufacturer for full drying or curing.

PART 2 PRODUCTS

2.01 WALL COVERINGS

A. General: Provide rolls of each type of wall covering from same print run or dye lot.

2.02 ACOUSTICAL WALL COVERING

A. See Attached Schedule.

2.03 VINYL WALL COVERING

A. Vinyl Wall-Covering Standards: Provide mildew-resistant products complying with the following:
   1. W-101 WA for Type II, Medium-Duty products.
   2. ASTM F793/F793M for wall coverings that qualify as Category V, Type II, Commercial Serviceability products.
   3. Perforated Vinyl Wall Covering: Provide perforations at all wall covering installed on exterior walls with vapor barrier.

B. See attached Schedule.

2.04 ACCESSORIES

A. Adhesive: Mildew-resistant, nonstaining, strippable adhesive, for use with specific wall covering and substrate application; as recommended in writing by wall-covering manufacturer and with a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   1. Adhesive for Perforated Vinyl Wall Covering: Primer and Adhesive to be vapor permeable per ASTM E96/E96M-02.
      a. Gardner-Gibson: Dynamite 234.
      b. Roman (Sherwin Williams): Eco 788.
      c. Or approved substitution.

B. Primer/Sealer: Mildew-resistant primer/sealer recommended in writing by wall-covering manufacturer for intended substrate.
   1. Primer for Perforated Vinyl Wall Covering: Primer and Adhesive to be vapor permeable per ASTM E96/E96M-02.
      a. Use manufacturer's recommended permeable primer.

C. Seam Tape: As recommended in writing by wall-covering manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for levelness, wall plumbness, maximum moisture content, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Comply with manufacturer's written instructions for surface preparation.

B. Clean substrates of substances that could impair bond of wall covering, including dirt, oil, grease, mold, mildew, and incompatible primers.

C. Prepare substrates to achieve a smooth, dry, clean, structurally sound surface free of flaking, unsound coatings, cracks, and defects.

1. Moisture Content: Maximum of 5 percent on new plaster, concrete, and concrete masonry units when tested with an electronic moisture meter.
2. Metals: If not factory primed, clean and apply metal as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
3. Gypsum Board: Prime with primer as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
4. Painted Surfaces: Treat areas susceptible to pigment bleeding.

D. Check painted surfaces for pigment bleeding. Sand gloss, semigloss, and eggshell finish with fine sandpaper.

E. Remove hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

F. Acclimatize wall-covering materials by removing them from packaging in the installation areas not less than 24 hours before installation.

3.03 INSTALLATION

A. General: Comply with wall-covering manufacturers' written installation instructions applicable to products and applications indicated except where more stringent requirements apply.

B. Cut wall-covering strips in roll number sequence. Change roll numbers at partition breaks and corners.

C. Install strips in same order as cut from roll.

D. Install reversing every other strip.

E. Install wall covering with no gaps or overlaps, no lifted or curling edges, and no visible shrinkage.

F. Match pattern 72 inches (1830 mm) above the finish floor.

G. Install seams vertical and plumb at least 6 inches (150 mm) from outside corners and 3 inches (75 mm) 6 inches (150 mm) from inside corners unless a change of pattern or color exists at corner. No horizontal seams are permitted.

H. Fully bond wall covering to substrate. Remove air bubbles, wrinkles, blisters, and other defects.

I. Trim edges and seams for color uniformity, pattern match, and tight closure. Butt seams without any overlay or spacing between strips.

3.04 CLEANING

A. Remove excess adhesive at finished seams, perimeter edges, and adjacent surfaces.

B. Use cleaning methods recommended in writing by wall-covering manufacturer.

C. Replace strips that cannot be cleaned.

D. Re-install hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

END OF SECTION

SECTION 09 72 01
WALL COVERINGS - SCHEDULES

1.01 ACOUSTICAL WALL COVERINGS

A. **AWC-7 (Not Used)**
1. Manufacturer: Wolf Gordon
2. Product ID: WG 7679345
3. Collection: Softrack
4. Style Name: SRI 985
5. Color: Sandalwood
6. Backing: Latex- Backed and Scotch Guarded
7. Location: Remodels Only
8. Contact: Jessica Nalipinski, 612-791-3080
9. URL: https://www.wolfgordon.com/products/wallcovering/softrack-soft-128aw

B. **AWC-13**
1. Manufacturer: Momentum
2. Product ID: ASIL-24
3. Collection: Silence
4. Color: Kiwi
5. Location: Kids Gym
6. Contact: Anne Tripp, Atripp@momtex.com, 952-240-4863
7. URL: https://momentumtextilesandwalls.com/products/09338668

C. **AWC-14**
1. Manufacturer: Koroseal
2. Product ID: CHD-219
3. Pattern: Chords
4. Color: Abalone
5. Width: 54”
6. Thickness: 4mm
7. Backing: Fused Poly
8. Content: Recycled Polyester
9. Location: Gyms and Movement Studio
10. Contact: Natalia Haywood natalia.haywood@koroseal.com
11. URL: https://koroseal.com/products/specialty/textiles-wallcoverings/chords/koroseal-chords-abalone

1.02 VINYL WALL COVERING

A. Vinyl Wall-Covering Standards: Provide mildew-resistant products complying with the following:
1. CFFA-W-101-D for Type II, Medium-Duty products.
2. ASTM F 793 for wall coverings that qualify as Category V, Type II, Commercial Serviceability products.

B. Perforated Vinyl Wall Covering: Provide perforations at all wall covering installed on exterior walls with vapor barrier, and interior walls opposite Yoga, Fitness Studios, Steam Room, Sauna, Locker room, Shower or Pool areas.

C. WC-1
1. Manufacturer: Wolf Gordon
2. Series: Summit
3. Pattern: Caribe
4. Color: Ventana CBE 6-1107
5. Product ID: WG 5588890

6. Width: 54”
7. Location: Field wall covering, refer to drawings.
8. Contact: Jessica Nalipinski, 612-791-3080

D. WC-3
1. Manufacturer: Wolf Gordon
2. Series: Haven
3. Pattern: Mumbai
4. Color: Haji MBI 9-2453
5. Product ID: WG 9047287
6. Width: 54”
7. Content: 100% Vinyl, Osnaburg backing
8. Location: Salon
9. Contact: Jessica Nalipinski, 612-791-3080
10. Lead Time: 6 weeks
11. URL: https://www.wolfgordon.com/products/wallcovering/mumbai-mbi-9-2453

E. WC-4A
1. Distributor: Koroseal
2. Manufacturer: Arte
3. Pattern: Sapphire
4. Color: 69184
5. Width: 52-54”
6. Content: Vinyl
7. Location: Salon Accent, Spa Waiting, Yoga, Recovery
8. Contact: Natalia Haywood natalia.haywood@koroseal.com
9. URL: https://koroseal.com/products/wallcoverings/sapphire/69184

F. WC-4B
1. Distributor: Koroseal
2. Manufacturer: Arte
3. Pattern: Sapphire
4. Color: 69193
5. Width: 51”
6. Content: Vinyl
7. Location: First floor circulation and Locker room accent, refer to drawings.
8. Contact: Natalia Haywood natalia.haywood@koroseal.com
9. URL: https://koroseal.com/products/wallcoverings/sapphire/69193

G. WC-4C
1. Distributor: Koroseal
2. Manufacturer: Arte
3. Pattern: Sapphire
4. Color: 69190
5. Width: 52-54"
6. Content: Vinyl, Type II
7. Location: Circulation
8. Contact: Natalia Haywood natalia.haywood@koroseal.com
9. URL: https://www.arte-international.com/en/arte-contract/sapphire/67450

H. WC-5A
1. Manufacturer: MDC
2. Pattern: Chipper
3. Color: Fog
4. Product ID: Alpha6654

5. Width: 52”
6. Content: Fabric-backed vinyl
7. Location: Field at Barre, Pilates, Cycle and Recovery
8. Contact: Kellan Baker, kbaker@mdcwall.com Tel: 952-232-9642
9. URL: https://www.mdcwall.com/product/type-ii-wall/y46867ci

I. WC-5B
1. Manufacturer: Maharam
2. Pattern: Nook
3. Color: Cave 024
4. Product ID: 399913
5. Width: 54”
6. Content: 100% Non-Phythalate Vinyl
7. Location: Accent - See drawings
8. Contact: Tracy Shand, tshand@maharam.com, 612-382-1116
9. URL: https://www.maharam.com/products/nook/colors/024-cave

J. WC-6A
1. Distributor: Koroseal
2. Manufacturer: Arte
3. Series: Signature
4. Pattern: Spark
5. Color: 24565
6. Width: 39.37”
7. Repeat: Straight match 30cm (11.81”)
8. Content: Vinyl on paper backing
9. Location: Coffee/Bar Accent
10. Contact: Natalia Haywood natalia.haywood@koroseal.com
11. URL: https://www.arte-international.com/en/collections/signature/spark/24565

K. WC-6B
1. Distributor: Koroseal
2. Manufacturer: Arte
3. Series: Signature
4. Pattern: Spark
5. Color: 24568
6. Content: Vinyl on paper backing
7. Width: 39.37”
8. Repeat: Straight match 30cm (11.81”)
9. Location: Accent - See drawings.
10. Contact: Natalia Haywood natalia.haywood@koroseal.com
11. URL: https://www.arte-international.com/en/collections/signature/spark/24568

L. WC-7
1. Manufacturer: Wolf Gordon
2. Series: London Chic
3. Pattern: Brixton
4. Color: Blue Steel BRX 8-3337
5. Product ID: WG 11810429
6. Content: 100% Vinyl, Osnaburg backing
7. Width: 54”
8. Location: Bar – Accent (Proto and Special Projects)
9. Contact: Jessica Nalipinski, 612-791-3080
10. Lead Time: 6 weeks
11. URL: https://www.wolfgordon.com/products/wallcovering/brixton-brx-8-3337

M. WC-8A
    1. Manufacturer: Maharam
    2. Pattern: Sari
    3. Color: Goldenrod 025
    4. Product ID: 399426
    5. Width: 54”
    6. Content: Non-Phthalate Vinyl
    7. Location: Kids Academy – Gold Accent, Activity/Movement Studios and Learning Lab
    8. Notes:
        a. Use PT-15 to paint access panels where VWC occurs. Refer to paint specs for info.
        b. Perforated Wallcovering - Minimum 30 yards and extra week to produce. Use at exterior walls only.
    9. Contact: Tracy Shand, tshand@maharam.com, 612-382-1116
    10. URL: https://www.maharam.com/products/sari/colors/025-goldenrod

N. WC-8B
    1. Manufacturer: Maharam
    2. Pattern: Sari
    3. Color: Picante 022
    4. Product ID: 399426
    5. Content: Non-Phthalate Vinyl
    6. Width: 54”
    7. Location: Kids Academy – Orange Accent, Learning/Language Studio, Kids Academy Gym throughout
    8. Contact: Tracy Shand, tshand@maharam.com, 612-382-1116
    9. Notes:
        a. Use PT-16 to paint access panels where VWC occurs. Refer to paint specs for info.
        b. Perforated Wallcovering - Minimum 30 yards and extra week to produce. Use at exterior walls only.
    10. URL: https://www.maharam.com/products/sari/colors/022-picante

O. WC-8C
    1. Manufacturer: Maharam
    2. Pattern: Sari
    3. Color: Lagoon 010
    4. Product ID: 399426
    5. Width: 54”
    6. Content: Non-Phthalate Vinyl
    7. Location: Kids Academy – Blue Accent - Toddler
    8. Contact: Tracy Shand, tshand@maharam.com, 612-382-1116
    9. Note:
        a. Use PT-17 to paint access panels where VWC occurs. Refer to paint specs for info.
        b. Perforated Wallcovering - Minimum 30 yards and extra week to produce. Use at exterior walls only.
    10. URL: https://www.maharam.com/products/sari/colors/010-lagoon

P. WC-8D
    1. Manufacturer: Maharam
    2. Pattern: Sari
    3. Color: Grass 006
    4. Product ID: 399426
    5. Width: 54”
    6. Content: Non-Phthalate Vinyl
    7. Location: LTKA see plans

8. Contact: Tracy Shand, tshand@maharam.com, 612-382-1116
9. Note:
    a. Use PT-40 to paint access panels where VWC occurs. Refer to paint specs for info.
    b. Perforated Wallcovering - Minimum 30 yards and extra week to produce. Use at exterior walls only.
10. https://www.maharam.com/maharam/products/sari/colors/006-grass

Q. WC-8E
1. Manufacturer: Maharam
2. Pattern: Sari
3. Color: Amethyst 017
4. Product ID: 399426
5. Width: 54”
6. Content: Non-Phthalate Vinyl
7. Installation: Stacked V
8. Location: LTKA see plans
9. Contact: Tracy Shand, tshand@maharam.com, 612-382-1116
10. Note:
    a. Perforated Wallcovering - Minimum 30 yards and extra week to produce. Use at exterior walls only.
11. https://www.maharam.com/products/sari/colors/017-amethyst

R. WC-9
1. Distributor: Goodlines Design
2. Manufacturer: Carnegie
3. Pattern: Kaleidoscope
4. Colorway: 8
5. Product ID: 6253
6. Width: 56”
7. Content: 100% IFR Xorel
8. Location: Recovery – Accent
9. Contact: Nick Nelson, nick@goodlinesdesign.com
10. URL: https://carnegiefabrics.com/kaleidoscope-6253-panels#878=17579

S. WC-11A
1. Distributor: Kravet
2. Manufacturer: Cole & Son
3. Pattern: Hicks Hexagon
4. Color: Gold Taupe
5. Product ID: 95/3017
6. Width: 20.5"
7. Content: 100% Paper
8. Location: Theater - Light
9. URL: https://www.kravet.com/hicks-hexagon-gold-taupe

T. WC-11B
1. Distributor: Kravet
2. Manufacturer: Cole & Son
3. Pattern: Hicks Hexagon
4. Color: Dark Grey/Bronze
5. Product ID: 95/3015
6. Width: 20.5"
7. Content: 100% Paper
8. Location: Theater - Dark
9. URL: https://www.kravet.com/hicks-hexagon-dk-gry-bronz

U. WC-12
   1. Distributor: Koroseal
   2. Manufacturer: Arte
   3. Series: Ligna
   4. Pattern: Hive
   5. Color: 42035 (high gloss metal foil)
   6. Width: 90cm (35.43”)
   7. Content: Non woven, high gloss metal foil
   8. Location: Entry Ceiling
   9. Contact: Natalia Haywood natalia.haywood@koroseal.com
   10. URL: https://www.arte-international.com/en/collections/ligna/hive/42035-high-gloss-metal-foil

V. WC-13A
   1. Distributor: Koroseal
   2. Manufacturer: Luxe Surfaces
   3. Pattern: Antwerp
   4. Color: Beringer
   5. Product ID: LXB-ATP-05
   6. Width: 52-54"
   7. Content: Vinyl, Type II
   8. Notes: Microvented at exterior walls
   9. Location: LTW and Club Lounge
   10. Contact: Natalia Haywood natalia.haywood@koroseal.com
   11. URL: https://www.luxesurfaces.com/wall-coverings/lxb-atp-05/

W. WC-15
   1. Distributor: DL Couch
   2. Manufacturer: Source One
   3. Pattern: Ruche
   4. Color: Smocking
   5. Product ID: 2VRU-03
   6. Content: 100% Vinyl
   7. Repeat: 12-5/8"V; 13-1/2"H
   8. Width: 54"
   9. Location: Nook
   10. Contact: Anne Tripp, atripp@dlcouch.com, 952-240-4863
   11. URL: https://www.memosamples.com/servlet/quickSearchSpecs.jsp?prodNo=09275242&patternPos=0&colorPos=4&chairImgKey=&backToPage=/servlet/quickSearch.jsp&favorites=&navDirection=detail&searchType=product

X. WC-16
   1. Manufacturer: Wolf Gordon
   2. Pattern: Bespoke
   3. Color: Fern
   4. Product ID: BSP 2871
   5. Width: 54"
   6. Content: 100% Vinyl
   7. Location: Restroom
   8. Contact: Holly Thompson, holly.thompson@wolfgordon.com, Tel: 612-791-3080
   9. URL: https://www.wolfgordon.com/products/wallcovering/bespoke-bsp-2871

Y. WC-17
   1. Manufacturer: Maharam
   2. Pattern: Symmetry 399595

3. Color: Carbon 011
4. Product ID: 399595-011
5. Content: 100% Vinyl
6. Width: 52"
7. Repeat: 18" V; 52" H
8. Location: Conference Room Accent
9. Contact: Tracy Shand, tshand@maharam.com, 612-382-1116
10. URL: https://www.maharam.com/products/symmetry/colors/011-carbon

Z. WC-19
1. Manufacturer: Wolf Gordon
2. Collection: Rampart
3. Pattern: Grain
4. Product ID: GOH 32116511
5. Color: Poplar
6. Width: 52"
7. Content: 100% Vinyl
8. Install: Reverse Hang, Random Match
9. Location: Accent, see drawings.
10. Contact: Jessica Nalipinski, 612-791-3080
11. URL: https://www.wolfgordon.com/products/wall-protection/grain-gai-5110

AA. WC-20B
1. Manufacturer: Wolf Gordon
2. Collection: Digital Rampart
3. Pattern: Tabby Emboss w/Custom Digital Print, Artwork provided by Life Time
4. Product ID: CDP 510/WG 32193184
5. Color: Custom
6. Width: 52-54"
7. Content: 100% Vinyl
8. Install: Straight match
9. Note: Coordinating paint color is PT-2
10. Location: Fitness Floor 3rd Level GTX Burn
11. Contact: Jessica Nalipinski, 612-791-3080

BB. WC-22A
1. Manufacturer: Maharam
2. Pattern: Honor Weave – Custom
3. Color: New Earthen
4. Product ID: 012001/019
5. Width: 54”
6. Content: Vinyl
7. Location: Accent at Circulation
8. Contact: Tracy Shand, tshand@maharam.com, 612-382-1116

CC. WC-22B
1. Manufacturer: Maharam
2. Pattern: Honor Weave – Custom
3. Color: Coal
4. Product ID: Custom Life Time Product
5. Width: 54”
6. Content: Vinyl
7. Location: Circulation
8. Contact: Tracy Shand, tshand@maharam.com, 612-382-1116

DD. WC-23
1. Manufacturer: Innovations
2. Collection:
3. Pattern: Alchemy
4. Product Id: Alc-004
5. Color: Pale Silver
6. Width: 54"
7. Content: Fabric/ Vinyl
8. Install: Non Match
9. Note: Coordinating Paint Color Is TBD
10. Location: Per Plans
11. Contact: Nancy Berge Morton, nancy@blendedblue.com

EE. WC-23A
1. Manufacturer: Innovations
2. Collection:
3. Pattern: Alchemy
4. Product Id: Alc-015
5. Color: Aged Brass
6. Width: 54"
7. Content: Fabric/ Vinyl
8. Install: Non Match
9. Note: Coordinating Paint Color Is TBD
10. Location: Per Plans
11. Contact: Nancy Berge Morton, nancy@blendedblue.com

FF. WC-24
1. Manufacturer: Maharam
2. Collection: Perch
3. Pattern:
4. Color: Hunter 019
5. Product ID: 399996
6. Width: 54”
7. Content: Vinyl
8. Location: Circulation
9. Contact: Holly Thompson@wolfgordon.com 612-791-3080

GG. WC-26
1. Distributor: Koroseal
2. Manufacturer: Arte
3. Pattern: Lazur
4. Color: 67571
5. Width: 52”
6. Content: Vinyl
7. Location: Pilates
8. Contact: Natalia Haywood natalia.haywood@koroseal.com
9. URL: https://www.arte-international.com/en/arte-contract/lazur/67571

HH. WC-27
1. Distributor: Koroseal
2. Manufacturer: Koroseal
3. Pattern: Otis
4. Color: Thassos T521-02
5. Width: 52-54"
6. Content: Vinyl

7. Location: LT Kids Academy
8. Contact: Natalia Haywood natalia.haywood@koroseal.com
9. URL: https://koroseal.com/products/wallcoverings/otis/thassos

II. WC-29
1. Manufacturer: Wolf Gordon
2. Collection: Sarulla
3. Product ID: GOH 33843761
4. Color: Sky
5. Dimensions: 54" W
6. Content: 100% Vinyl
7. Location: Infants
8. Pricing Contact: Alfredo Ortiz; Alfredo.Ortiz@wolfgordon.com
9. Sales Representative: Jessica Nalipinski; Jessica.Nalipinski@wolfgordon.com
URL: https://url.usb.m.mimecastprotect.com/s/1zW5CxoWGrivKlzQsgFlUyQS96?domain=wolfgordon.com

JJ. WC-29A
1. Distributor: Koroseal
2. Manufacturer: Vescom
3. Series: Sagara
4. Color: 1106.10
5. Width: 52-54"
6. Content: Vinyl
7. Location: LT Kid's Activities Studio
8. Contact: Natalia Haywood natalia.haywood@koroseal.com
9. URLhttps://vescom.com/en-us/products/sagara

KK. WC-29B
1. Distributor: Koroseal
2. Manufacturer: Vescom
3. Series: Sagara
4. Color: 1106.44
5. Width: 52-54"
6. Content: Vinyl
7. Location: LT Kid's Activities Studio
8. Contact: Natalia Haywood natalia.haywood@koroseal.com
9. URL: https://vescom.com/en-us/products/sagara

LL. WC-30
1. Manufacturer: Momentum
2. Pattern: Englewood
3. Color: Antique Oak
4. Product ID: NA-3M-LF526
5. Content: 100% Vinyl
6. Width: 54"
7. Location: Millwork band on Fitness Floor
8. Contact:Jen Williams Email: JWilliams@momtex.com
9. URL: https://momentumtextilesandwalls.com/products/09543862

1.03 TACKABLE WALL COVERING

A. TAC-6
1. Manufacturer: Forbo Flooring
2. Series: Bulletin Board

3. Color: 2206 Oyster shell
4. Dimensions: See Drawings

1.04 SCHEDULE OF FACEPLATE AND WIRING DEVICES COLORS BY WALL FINISH:

A. White faceplates are to be used on walls with the following finishes:
   1. WC-1
   2. WC-3
   3. WC-4C
   4. WC-5A
   5. WC-13A
   6. WC-23
   7. WC-25

B. All other faceplates and wiring devices installed on wallcovering are to be black.

END OF SECTION

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SECTION 09 75 00
INTERIOR STONE

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Stone countertops.
   2. Benches.
   3. Wall caps.
   4. Soap dishes in shower.

1.02 RELATED SECTIONS

A. Section 01 31 00 - Project Management and Coordination.

B. Section 01 33 00 - Submittal Procedures.

C. Section 01 40 00 - Quality Requirements.

D. Section 01 60 00 - Product Requirements.

E. Section 01 92 00 - Facility Operation and Maintenance.

F. Section 09 21 16 - Gypsum Board Assemblies.

G. Section 09 21 17 - Gypsum Board Shaft Wall Assemblies.

H. Section 09 30 00 - Tiling.

I. Section 09 72 00 - Wall Coverings.

J. Section 09 74 16 - Flexible Wood Veneer Wall Covering.

K. Section 09 75 01 - Interior Stone Schedules.

L. Section 09 84 14 - Acoustic Stretched-Fabric Wall Systems.

M. Section 09 84 30 - Sound Absorbing Wall and Ceiling Units.

N. Section 09 91 00 - Painting.

O. Section 12 56 90 - Spa Furniture.

1.03 REFERENCE STANDARDS

1. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; Current Edition.
2. ANSI A118.3 - American National Standard Specifications for Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy and Water Cleanable Tile-Setting Epoxy Adhesive; 2021.
3. ILI (HB) - Indiana Limestone Handbook; 2007.
4. MIA (DM) - Dimension Stone Design Manual; Current Edition.
5. NBGQA (SPEC) - Specifications for Architectural Granite, Version 20-1; 2020.

1.04 SUBMITTALS

A. Product Data: For the following:
   1. Each variety of stone.
   2. Stone installation materials and other manufactured products.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

C. Samples for Verification:
   1. For each stone type indicated, in sets of Samples not less than 12 inches (300 mm) square. Include two or more Samples in each set and show the full range of variations in appearance characteristics expected in completed Work. Samples will establish the standard by which stone will be judged.
   2. For each color of grout and sealant required.

D. Sealant Compatibility Test Report: From sealant manufacturer, complying with requirements in Division 7 Section "Joint Sealants" and indicating that sealants will not stain or damage stone.

E. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.
   3. See Sections 01 33 00 and 01 60 00.

F. Operation and Maintenance Data: Submit O&M manuals according to the requirements of Section 01 92 00 - Facility Operation and Maintenance.

1.05 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate interior stone similar in material, design, and extent to that indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.

C. Installer Qualifications: Fabricator of interior stone.

D. Source Limitations for Stone: Obtain each variety of stone, regardless of finish, from a single quarry, whether specified in this Section or in another Section, with resources to provide materials of consistent quality in appearance and physical properties.

E. Source Limitations for Other Materials: Obtain each type of grout, stone accessory, sealant, and other material through one source from a single manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Lift stone with wide-belt slings; do not use wire rope or ropes that might cause staining. Move stone, if required, using dollies with cushioned wood supports.

B. Store stone on wood A-frames or pallets with non-staining separators and non-staining, waterproof covers. Ventilate under covers to prevent condensation.

C. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

1.07 PROJECT CONDITIONS

A. Maintain air and material temperatures to comply with requirements of installation material manufacturers, but not less than 50 deg F (10 deg C) during installation and for 7 days after completion.

B. Field Measurements: Verify dimensions of construction to receive interior stone by field measurements before fabrication and indicate measurements on Shop Drawings.
   1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabrication without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.08 COORDINATION

A. Coordinate installation of inserts that are to be embedded in concrete or masonry and similar items to be used by interior stone Installer for anchoring and supporting interior stone. Furnish setting drawings, templates, and directions for installing such items and deliver to Project site in time for installation.

B. Time delivery and installation of interior stone to avoid extended on-site storage and to coordinate with work adjacent to interior stone.

PART 2 PRODUCTS

2.01 SEE ATTACHED SCHEDULE

2.02 SETTING MATERIALS

A. Adhesives, General: Use only adhesives formulated for stone and recommended by their manufacturer for the application indicated.

B. Water-Cleanable Epoxy Adhesive: ANSI A118.3, with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24)].
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Laticrete International, Inc.
      b. MAPEI Corp.
      c. Summitville Tiles, Inc.
      d. Akemi.

2.03 STONE ACCESSORIES

A. Vent Grommets: Doug Mockett & Company, 2-1/2” Air Vent Grommet Cap Set, Model # EDPAVG3, color: matte black, or similar.

B. Temporary Setting Shims: Rigid plastic shims, non-staining to stone, sized to suit joint thickness.

C. Cleaner: Stone cleaner specifically formulated for stone types, finishes, and applications indicated, as recommended by stone producer. Do not use cleaning compounds containing acids, caustics, harsh fillers, or abrasives.

D. Stone Sealer: Colorless, stain-resistant sealer that does not affect color or physical properties of stone surfaces, as recommended by stone producer for application indicated.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Bostik Findley Inc.
      b. Custom Building Products.
      c. HMK Stone Care System.
      d. Stonecare International.
      e. Summitville Tiles, Inc.

2.04 STONE FABRICATION, GENERAL

A. Select stone for intended use to prevent fabricated units from containing cracks, seams, and starts that could impair structural integrity or function.
   1. Repairs that are characteristic of the varieties specified are acceptable provided they do not impair structural integrity or function and are not aesthetically unpleasing, as judged by Architect.

B. Fabricate interior stone in sizes and shapes required to comply with requirements indicated, including details on Drawings and Shop Drawings.
   1. For granite, comply with recommendations in NBGQA (SPEC) "Specifications for Architectural Granite."
   2. For limestone, comply with recommendations in ILI (HB) "Indiana Limestone Handbook."
   3. Cut stone to produce pieces of thickness, size, and shape indicated and to comply with fabrication and construction tolerances recommended by applicable stone association.
   4. Where items are installed with adhesive or where edges of stone is visible in the finished work, make items uniform in thickness and of identical thickness for each type of item; gage back of stone if necessary.
   5. Clean sawed backs of stones to remove rust stains and iron particles.
   6. Dress joints straight and at right angle to face, unless otherwise indicated.
   7. Cut and drill sinkages and holes in stone for anchors, supports, and lifting devices as indicated or needed to set stone securely in place; shape beds to fit supports.
   8. Provide openings, reveals, and similar features as needed to accommodate adjacent work.

C. Finish exposed faces and edges of stone to comply with requirements indicated for finish of each type of stone required and to match approved Samples.

D. Carefully inspect finished stone units at fabrication plant for compliance with requirements for appearance, material, and fabrication. Replace defective units.
   1. Grade and mark stone for overall uniform appearance when assembled in place. Natural variations in appearance are acceptable if installed stone units match range of colors and other appearance characteristics represented in approved Samples.

2.05 STONE COUNTERTOPS

A. General: Comply with recommendations in MIA (DM) "Dimension Stone - Design Manual."

B. Nominal Thickness: Provide thickness indicated, but not less than 1-1/4 inches (32 mm). Gage backs to provide units of identical thickness.

C. Edge Detail: 1-1/4 inch (20-mm) (3 cm) 1/8 inch eased at top and bottom edges.

D. Splashes: Provide 3/4-inch- (20-mm-) thick backsplashes and end splashes, unless otherwise indicated.
   1. Height: 4 inches (100 mm).
   2. Top-Edge Detail: Straight, slightly eased at corner.

E. Joints: Fabricate countertops in sections for joining in field, with joints at locations indicated and as follows:
   1. Color match stone epoxy all seams. Black at Verde Butterfly, Clear or Shaded at Santa Cecilia. 1/16 inch (1.5 mm) in width.

F. Cutouts and Holes:
   1. Under-counter Fixtures: Make cutouts for under-counter fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.
      a. Provide vertical edges, slightly eased at juncture of cutout edges with top and bottom surfaces of countertop and projecting 3/16 inch (5 mm) into fixture opening.
   2. Counter-Mounted Fixtures: Prepare countertops in shop for field cutting openings for counter-mounted fixtures. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.
   3. Fittings: Drill countertops in shop for plumbing fittings, under-counter soap dispensers, and similar items.

2.06 STONE BENCHES

A. Tops:
   1. Nominal Thickness: 1-1/4 inch (3 cm), unless otherwise indicated.
   2. Edge Detail: 1/8 inch (10-mm) radius eased at top edge and polished back at underside – 2 inch min., bottom corner slightly eased.
   3. Corner Detail: Match top edge.
   4. Bottom Surface Finish: Smooth.

2.07 STONE WALL CAPS AND SOAP SHELVES

A. Tops:
   1. Nominal Thickness: 1-1/4 inch (3 cm), unless otherwise indicated.
   2. Edge Detail: 1/8 inch Radius Eased @ Top Edge
   3. Corner Detail: Match top edge.
   4. Bottom Surface Finish: Polish underside
   5. Soap Shelf: 1/8 inch Radius Eased

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine surfaces indicated to receive interior stone and conditions under which interior stone will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Clean dirty or stained stone surfaces by removing soil, stains, and foreign materials before setting. Clean stone by thoroughly scrubbing with fiber brushes and then drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh materials or abrasives.

3.03 SETTING OF STONE, GENERAL

A. Do necessary field cutting as stone is set. Use power saws with diamond blades to cut stone. Cut lines straight and true, with edges eased slightly to prevent snipping. Wet-cutting is preferred.

B. Contiguous Work: Provide reveals and openings as required to accommodate contiguous work.

C. Set stone to comply with requirements indicated on Drawings and Shop Drawings. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure stone in place. Shim and adjust anchors, supports, and accessories to set stone accurately in locations indicated, with edges and faces aligned according to established relationships and indicated tolerances.

D. Erect stone units level, plumb, and true with uniform joint widths. Use temporary shims to maintain joint width.

3.04 CONSTRUCTION TOLERANCES

A. Variation from Plumb: For vertical lines and surfaces, do not exceed 1/8 inch in 96 inches (3 mm in 2400 mm), 1/4 inch (6 mm) maximum.

B. Variation from Level: For lintels, sills, chair rails, horizontal bands, horizontal grooves, and other conspicuous lines, do not exceed 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), 3/8 inch (10 mm) maximum.

C. Variation in Joint Width: Do not vary joint thickness more than 1/16 inch (1.5 mm) or 1/4 of nominal joint width, whichever is less.

D. Variation in Plane between Adjacent Stone Units (Lipping): Do not exceed 1/32-inch (0.8-mm) difference between planes of adjacent units.

3.05 INSTALLATION OF STONE COUNTERTOPS

A. General: Install countertops by adhering to supports with water-cleanable epoxy adhesive.

B. Set stone to comply with requirements indicated on Drawings and Shop Drawings. Shim and adjust stone to locations indicated, with uniform joints of widths indicated and with edges and faces aligned according to established relationships.

C. Space joints with 1/16-inch (1.5-mm) gap for filling with color match epoxy. Use temporary shims to ensure uniform spacing.

D. Clamp units to temporary bracing, supports, or each other to ensure that countertops are properly aligned and joints are of specified width.

E. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Use power saws with diamond blades to cut stone. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.

F. Install backsplash and end splash by adhering to wall with 100% silicone adhesive. Leave 1/16-inch (1.5-mm) gap between countertop and splash for filling with sealant. Use temporary shims to ensure uniform spacing.

3.06 INSTALLATION OF STONE WALL CAPS

A. Stone Caps at Walls: Adhere units to tile backer or concrete masonry with 100% silicone adhesive. Shim/clamp as needed until dry, remove shims, epoxy (color match) joints.

3.07 INSTALLATION OF STONE BENCHES

A. Stone Bench Tops: Set stone bench tops on concrete or masonry bases in thin set. Shim/clamp as needed until dry, remove shims, epoxy (color match) joints.

3.08 JOINT-SEALANT INSTALLATION

A. Prepare joints and apply sealants of type and at locations indicated to comply with applicable requirements in Division 7 Section "Joint Sealants." Remove temporary shims before applying sealants.

3.09 ADJUSTING AND CLEANING

A. In-Progress Cleaning: Clean interior stone as work progresses. Remove adhesive, grout, mortar, and sealant smears immediately.

B. Remove and replace interior stone of the following description:
   1. Broken, chipped, stained, or otherwise damaged stone. Stone may be repaired if methods and results are approved by Architect.
   2. Defective stone.
   3. Defective joints, including misaligned joints.
   4. Interior stone and joints not matching approved Samples and mockups.
   5. Interior stone not complying with other requirements indicated.

C. Replace in a manner that results in interior stone's matching approved Samples and mockups, complying with other requirements, and showing no evidence of replacement.

D. Clean interior stone no fewer than six days after completion of grouting and pointing, using clean water and soft rags or stiff-bristle fiber brushes. Do not use wire brushes, acid-type cleaning agents, cleaning compounds with caustic or harsh fillers, or other materials or methods that could damage stone.

E. Sealer Application: Apply stone sealer to comply with stone producer's and sealer manufacturer's written instructions and recommendations.

3.10 PROTECTION

A. Protect stone surfaces, edges, and corners from construction damage. Use securely fastened untreated wood, plywood, or heavy cardboard to prevent damage.

B. Before inspection for Substantial Completion, remove protective coverings and clean surfaces.

END OF SECTION

SECTION 09 75 01
INTERIOR STONE - SCHEDULE

PART 2 PRODUCTS

1.01 GRANITE

A. Cut stone from contiguous, matched slabs in which natural markings occur.

B. Granite: Comply with ASTM C615.

C. STN-1:
   1. Manufacturer: Daltile
   2. Color: Verde Butterfly
   3. Thickness: 1-1/4”, 3 cm
   4. Finish: Polished
   5. Nosing: Eased Edge- 1/8 inch radius eased at top and bottom

6. Location: Non-member facing offices, Locker room bench

SECTION 09 75 01
INTERIOR STONE - SCHEDULE

PART 2 PRODUCTS

1.01 GRANITE

A. Cut stone from contiguous, matched slabs in which natural markings occur.

B. Granite: Comply with ASTM C615.

C. STN-1:
1. Manufacturer: Daltile
2. Color: Verde Butterfly
3. Thickness: 1-1/4", 3 cm
4. Finish: Polished
5. Nosing: Eased Edge- 1/8 inch radius eased at top and bottom
6. Location: Non-member facing offices, Locker room benches, towel drops and soap shelves.
7. Contact: Amy McMacken, 734.218.4995, amy.mcmacken@daltile.com
8. URL: http://daltilestonecenter.com/StGeorge/ProductDetail.aspx?ID=682

D. STN-1A:
1. Manufacturer: Daltile
2. Color: Verde Butterfly
3. Thickness: 3/4", 2 cm
4. Finish: Polished
5. Nosing: Eased Edge- 1/8 inch radius eased at top and bottom
6. Location: Vanity Skirts, Backsplashes, Towel Shelves.
7. Contact: Amy McMacken, 734.218.4995, amy.mcmacken@daltile.com
8. URL: http://daltilestonecenter.com/StGeorge/ProductDetail.aspx?ID=682

E. STN-14:
1. Manufacturer: Daltile
2. Color: Luce Di Luna
3. Thickness: 1.25"
4. Finish: Polished
5. Nosing: Eased Edge
6. Sealer: Stonetech Sealer, See Section 09 30 00.
7. Location: Stone throughout, refer to drawings.

F. STN-15:
1. Manufacturer: Daltile
2. Color: Biscotti White G7777
3. Thickness: 3cm, 1 ¼"
4. Finish: Polished
5. Nosing: Eased Edge
6. Location: Stone throughout, refer to drawings.
7. URL: https://www.daltile.com/products/stone/granite-+-natural-stone-slab/slab/biscottiwhite/polished/standard

G. STN-15A:
1. Manufacturer: Daltile
2. Color: Biscotti White G7777
3. Thickness: 2cm, ¾"
4. Finish: Polished
5. Nosing: Eased Edge
6. Location: Vanity skirts, Backsplashes as required.

es, towel drops and soap shelves.
7. Contact: Amy McMacken, 734.218.4995, amy.mcmacken@daltile.com
8. URL: http://daltilestonecenter.com/StGeorge/ProductDetail.aspx?ID=682

D. STN-1A:
1. Manufacturer: Daltile
2. Color: Verde Butterfly
3. Thickness: 3/4", 2 cm
4. Finish: Polished
5. Nosing: Eased Edge- 1/8 inch radius eased at top and bottom
6. Location: Vanity Skirts, Backsplashes, Towel Shelves.
7. Contact: Amy McMacken, 734.218.4995, amy.mcmacken@daltile.com
8. URL: http://daltilestonecenter.com/StGeorge/ProductDetail.aspx?ID=682

E. STN-14:
1. Manufacturer: Daltile
2. Color: Luce Di Luna
3. Thickness: 1.25"
4. Finish: Polished
5. Nosing: Eased Edge
6. Sealer: Stonetech Sealer, See Section 09 30 00.
7. Location: Stone throughout, refer to drawings.

F. STN-15:
1. Manufacturer: Daltile
2. Color: Biscotti White G7777
3. Thickness: 3cm, 1 ¼"
4. Finish: Polished
5. Nosing: Eased Edge
6. Location: Stone throughout, refer to drawings.
7. URL: https://www.daltile.com/products/stone/granite-+-natural-stone-slab/slab/biscottiwhite/polished/standard

G. STN-15A:
1. Manufacturer: Daltile
2. Color: Biscotti White G7777
3. Thickness: 2cm, ¾"
4. Finish: Polished
5. Nosing: Eased Edge
6. Location: Vanity skirts, Backsplashes as required.
7. URL: https://www.daltile.com/products/stone/granite-+-natural-stone-slab/slab/biscottiwhite/polished/standard

H. STN-17:
1. Manufacturer: Daltile
2. Color: Uba Tuba G761
3. Thickness: 1-1/4", 3 cm
4. Finish: Polished
5. Nosing: Eased Edge- 1/8 inch radius eased at top and bottom
6. Location: Non-member facing offices, Locker room benches, towel drops and soap shelves.
7. Contact: Amy McMacken, 734.218.4995, amy.mcmacken@daltile.com
8. URL: http://daltilestonecenter.com/StGeorge/ProductDetail.aspx?ID=682

I. STN-17A:
1. Manufacturer: Daltile
2. Color: Uba Tuba G761
3. Thickness: 3/4", 2 cm

4. Finish: Polished
5. Nosing: Eased Edge- 1/8 inch radius eased at top and bottom
6. Location: Vanity Skirts, Backsplashes, Towel Shelves.
7. Contact: Amy McMacken, 734.218.4995, amy.mcmacken@daltile.com
8. URL: http://daltilestonecenter.com/StGeorge/ProductDetail.aspx?ID=682

J. STN-18:
1. Manufacturer: AKDO
2. Series: Moss Green
3. Color: Moss Green (H)
4. SKU: MB1088-SL34H0
5. Finish: Matte
6. Size: 124" x 72" x 3/4" slab
7. Installation: Stacked
8. Grout: n/a
9. Location: Bench Seats in locker rooms
10. Contact: Lynn Deschamps lynn.deschamps@akdo.com
11. URL: https://professional.akdo.com/materials/stone/slabs/marble/8826346-moss-green-h--slab/

1.02 QUARTZ

A. QTZ-17
1. Manufacturer: Cambria
2. Quartz Surface: 93% pure quartz with polyester resin, pigments and special effects.
3. Complying with ASTM C97, ASTM C99, ASTM C170, ASTM C501
4. Mounting Adhesive: Structural grade ’50 year’ 100% silicone or epoxy adhesive
5. Collection: Luxury Series
6. Color: Brittanicca Gold Warm
7. Finish: Matte.
8. Size: 65 ½” x 132” (Jumbo).
9. Fabricated to site specific requirements by regional, Cambria-authorized fabricators
10. Thickness: 2 cm, 3 cm
11. Nosing: Ridgeline Edge (TR3)
12. Joint Sealant: Clear
13. Location: See Plans
14. Contact:Kalna Bobyn, 952.944.1676

B. QTZ-17P
1. Manufacturer: Cambria
2. Quartz Surface: 93% pure quartz with polyester resin, pigments and special effects.
3. Complying with ASTM C97, ASTM C99, ASTM C170, ASTM C501
4. Mounting Adhesive: Structural grade ’50 year’ 100% silicone or epoxy adhesive
5. Collection: Luxury Series
6. Color: Brittanicca Gold Warm
7. Finish: Polished.
8. Size: 65 ½” x 132” (Jumbo).
9. Fabricated to site specific requirements by regional, Cambria-authorized fabricators
10. Thickness: 2 cm, 3 cm
11. Nosing: Ridgeline Edge (TR3)
12. Joint Sealant: Clear
13. Location: See Plans
14. Contact: Kalna Bobyn, 952.944.1676

C. QTZ-18
1. Manufacturer: Cambria
2. Quartz Surface: 93% pure quartz with polyester resin, pigments and special effects.

3. Complying with ASTM C97, ASTM C99, ASTM C170, ASTM C501
4. Mounting Adhesive: Structural grade ’50 year’ 100% silicone or epoxy adhesive
5. Collection: Signature Series
6. Color: CHARLESTOWN
7. Finish: Matte.
8. Size: 65 ½” x 132” (Jumbo).
9. Fabricated to site specific requirements by regional, Cambria-authorized fabricators
10. Thickness: 2cm, 3cm
11. Nosing: Ridgeline Edge (TR3)
12. Joint Sealant: Clear
13. Location: See plans
14. Contact: Kalna Bobyn, 952.944.1676

D. QTZ-18P
1. Manufacturer: Cambria
2. Quartz Surface: 93% pure quartz with polyester resin, pigments and special effects.
3. Complying with ASTM C97, ASTM C99, ASTM C170, ASTM C501
4. Mounting Adhesive: Structural grade ’50 year’ 100% silicone or epoxy adhesive
5. Collection: Signature Series
6. Color: CHARLESTOWN
7. Finish: Polished.
8. Size: 65 ½” x 132” (Jumbo).
9. Fabricated to site specific requirements by regional, Cambria-authorized fabricators
10. Thickness: 2cm, 3cm
11. Nosing: Ridgeline Edge (TR3)
12. Grout Color: Midnight Black #22
13. Location: Reception Desk, Focal Walls.
14. Contact: Kalna Bobyn, 952.944.1676

END OF SECTION

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SECTION 09 84 30
SOUND ABSORBING WALL AND CEILING UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Sound-absorbing ceiling baffles.

B. Mounting accessories.

1.02 RELATED REQUIREMENTS

A. Section 01 33 00 - Submittal Procedures.

B. Section 01 40 00 - Quality Requirements.

C. Section 01 60 00 - Product Requirements.

D. Section 09 21 16 - Gypsum Board Assemblies.

E. Section 09 51 13 - Acoustic Panel Ceilings.

F. Section 09 74 16 - Flexible Wood Veneer Wall Covering.

G. Section 09 75 00 - Interior Stone.

H. Section 09 91 00 - Painting.

1.03 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's printed data sheets for products specified.

C. Shop Drawings: Fabrication and installation details, panel layout, and fabric orientation.

D. Selection Samples: Manufacturer's color charts for fabric covering, indicating full range of fabrics, colors, and patterns available.

E. Verification Samples: Fabricated samples of each type of panel specified; 12 by 12 inch (305 by 305 mm), showing construction, edge details, and fabric covering.

F. Test Reports: Certified test data from an independent test agency verifying that panels meet specified requirements for acoustical and fire performance.

G. Manufacturer's Qualification Statement.

H. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Construction Manager within 5 days of delivery of materials.
   3. See Sections 01 33 00 and 01 60 00.

I. Maintenance Materials: Furnish the following for Operator's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, for additional provisions.
   2. Extra Panels: Quantity equal to 5 percent of total installed, but not less than one of each type.

1.05 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Manufacturer Qualifications: Company with not less than five years of experience in manufacturing acoustical products similar to those specified.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect acoustical units from moisture during shipment, storage, and handling. Deliver in factory-wrapped bundles; do not open bundles until units are needed for installation.

B. Store units flat, in dry, well-ventilated space; do not stand on end.

C. Protect edges from damage.

PART 2 PRODUCTS

2.01 FABRIC-COVERED SOUND-ABSORBING BAFFLES

A. B-3
   1. Basis of Design:
      a. Manufacturers: CSI Creative
   2. Product ID: BFL-FLD-002
   3. Acoustics: 0.75-0.95 NRC
   4. Flammability: ASTM E84: Class A.
   5. Material: 12mm acoustic PET substrate
   6. Color: Abalone SND131
   7. Panel Size: 10" H x 1” D x 9'-0" L, typical – Refer to RCP for specific Lengths
   8. Patterns: As indicated on Drawings
   9. Spacing: 14" OC
   10. Installation: Rail suspension by manufacturer.
      a. CSI substrate clad linear system with No. 1 cable

2.02 FABRICATION

A. Fabricate panels to sizes and configurations as indicated, with facing installed without sagging, wrinkles, blisters, or visible seams.
   1. For panels suspended from ceiling, provide facing covering both sides, with seams only at panel edges.

B. Tolerances: Fabricate to finished tolerance of plus or minus 1/16 inch (1.6 mm) for thickness, overall length and width, and squareness from corner to corner.

2.03 ACCESSORIES

A. Ceiling-Suspended Accessories: Manufacturer's standard accessories at locations as indicated on each acoustical unit, sized appropriately for weight of acoustical unit.

B. Fixing Clips: Manufacturers standard for application as indicated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates for conditions detrimental to installation of acoustical units. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install acoustical units in locations as indicated, following manufacturer's installation instructions.

B. Suspend ceiling baffles at locations and heights as indicated.

C. Install acoustical units to construction tolerances of plus or minus 1/16 inch (1.6 mm) for the following:
   1. Plumb and level.
   2. Flatness.

3.03 CLEANING

A. Clean fabric facing upon completion of installation from dust and other foreign materials, following manufacturer's instructions.

3.04 PROTECTION

A. Provide protection of installed acoustical panels until Date of Substantial Completion.

B. Replace panels that cannot be cleaned and repaired to satisfaction of the Architect.

END OF SECTION

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SECTION 09 91 00
PAINTING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Paint systems including application on the following substrates:
      a. Concrete.
      b. Masonry.
      c. Ferrous Metal
      d. Non-Ferrous Metal.
      e. Gypsum board.
      f. Wood.
   2. Powder Coating systems including application on the following substrates:
      a. Ferrous Metal
      b. Non-Ferrous Metal.
   3. Products include applications for the following conditions:
      a. Interior/Dry Environment.
      b. Interior/Wet Chemical Environment.
      c. Interior/Wet Environment.
      d. Exterior.
   4. See the following sections for coating of other surfaces:
      a. 06 40 00 - Architectural Woodwork.
      b. 07 81 60 - Intumescent Fireproofing.

1.02 RELATED SECTIONS

A. Section 01 33 00 - Submittal Procedures.

B. Section 01 40 00 - Quality Requirements.

C. Section 01 60 00 - Product Requirements.

D. Section 03 30 00 - Cast-in-Place Concrete.

E. Section 04 20 00 - Unit Masonry Assemblies.

F. Section 05 12 00 - Structural Steel Framing.

G. Section 05 40 00 - Cold-Formed Metal Framing.

H. Section 05 50 00 - Metal Fabrications.

I. Section 06 40 00 - Architectural Woodwork

J. Section 07 24 20 - Polymer Based Interior Finish System.

K. Section 07 81 60 - Intumescent Fireproofing.

L. Section 08 11 13 - Hollow Metal Doors and Frames.

M. Section 09 21 16 - Gypsum Board Assemblies.

N. Section 09 91 01 - Painting Schedules.

1.03 REFERENCE STANDARDS

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; Current Edition.

B. GreenSeal GS-11 - Standard for Paints, Coatings, Stains, and Sealers; 2021, with Editorial Revision (2024).

C. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association; Current Edition.

D. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.

E. SCAQMD 1113 - Architectural Coatings; 1977, with Amendment (2016).

F. USGBC LEED-CI - LEED Green Building Rating System for Commercial Interiors; 2016.

1.04 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Verification: For each type of paint system and in each color and gloss of topcoat indicated.
   1. Submit Samples (3) on rigid backing, 8 inches (200 mm) square.
   2. Step coats on Samples to show each coat required for system.
   3. Label each coat of each Sample.
   4. Label each Sample for location and application area.

C. Product List: For each product indicated, include the following:
   1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
   2. Printout of current MPI (APL) "Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

D. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.
   3. See Sections 01 33 00 – Submittal Procedure and 01 60 00 – Product Requirements.

1.05 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. MPI Standards:
   1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
   2. Preparation and Workmanship: Comply with requirements in MPI (APSM) "Architectural Painting Specification Manual" for products and paint systems indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
   1. Maintain containers in clean condition, free of foreign materials and residue.
   2. Remove rags and waste from storage areas daily.

1.07 PROJECT CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Sherwin Williams Company, or comparable product by one of the following:
   1. Benjamin Moore & Co.
   2. Diamond Vogel Paints.
   3. Hirshfield's, Inc.
   4. PPG.

B. If a specific Manufacturer/Product is given in the Paint Schedule, furnish only that product for given application. Provide primers as recommended by that product's Manufacturer.

C. Match paint color provided in Schedule.

2.02 PAINT, GENERAL

A. Material Compatibility:
   1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
   2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. VOC Content of Field-Applied Interior Paints and Coatings: Provide products that comply with the following limits for VOC content, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24); these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:
   1. Low-Emitting Materials:
      a. Architectural paints and coatings applied on the building interior shall not exceed the VOC content limits established in GreenSeal GS-11 and USGBC LEED-CI
      b. Anti-corrosive and anti-rust paints applied to interior ferrous metal substrates must not exceed the VOC content limit of 250 g/L established in GreenSeal GS-11, 2.5.
      c. Clear wood finishes, floor coatings, stains, primers, and shellacs applied to interior elements must not exceed VOC content limits established in SCAQMD 1113, Architectural Coatings.
   2. Colors: As indicated in a color schedule.

2.03 PAINTING SYSTEMS

A. Interior Dry Environment:
   1. Gypsum Board walls and ceilings, Typ.
      a. Primer:
         1) Interior Latex Primer, MPI #50
      b. Topcoat, (2) coats of paint as indicated by surface:
         1) Interior Latex, MPI #53 (Flat)
         2) Interior Latex, MPI #54 (Semi-Gloss, enamel finish required)
   2. Masonry, Concrete walls, Typ.
      a. Primer:
         1) Block Filler MPI #4.
      b. Topcoat, (2) coats:
         1) Interior Latex, MPI #53
   3. Wood, where indicated to be painted. Coordinate with millwork supplier.
      a. Primer:
         1) Shop primed.
         2) Where not shop primed, Interior Latex, MPI #39
      b. Topcoat
         1) Alkyd, MPI #168
   4. Non-galvanized Steel.
      a. Primer:
         1) Shop primed as specified
         2) Anti-Corrosive Alkyd primer, MPI #79
      b. Topcoat, (2) coats:
         1) Alkyd, MPI #51, #47, #48; see below for gloss level per application
   5. Galvanized Steel or Aluminum.
      a. Primer:
         1) Water Based MPI #134
      b. Topcoat, (2) coats:

1) Alkyd, MPI #51, #47, #48; see below for gloss level per application.

B. Interior Pool, Mechanical and Chemical Storage Areas:
   1. Glass-Mat Gypsum Board or Cement Board.
      a. Primer:
         1) Interior Latex Primer, MPI #50
      b. Topcoat, (2) coats:
         1) Water Based Catalyzed Epoxy, MPI #115
   2. Masonry, Concrete walls.
      a. Primer:
         1) Block Filler MPI #4.
      b. Topcoat, (2) coats:
         1) Water Based Catalyzed Epoxy, MPI #115
   3. Non-galvanized Steel.
      a. Primer:
         1) Shop primed as specified
         2) Water-based Rust inhibitive primer, MPI #107
      b. Topcoat, (2) coats:
         1) Water Based Catalyzed Epoxy, MPI #115
   4. Galvanized Steel or Aluminum.
      a. Primer:
         1) Shop primed as specified
         2) Water-based Rust inhibitive primer, MPI #107
      b. Topcoat, (2) coats:
         1) Water Based Catalyzed Epoxy, MPI #115

C. Other Interior Wet areas (Locker rooms, Vanities, Toilets, etc):
   1. Gypsum Board walls and ceilings, Typ.
      a. Primer:
         1) Interior Latex Primer, MPI #50
      b. Topcoat, (2) coats:
         1) Anti-Microbial Interior Latex, MPI #53
   2. Non-galvanized Steel.
      a. Primer:
         1) Shop primed as specified
         2) Water-based Rust inhibitive primer, MPI #107
      b. Topcoat, (2) coats:
         1) Alkyd, MPI #51, #47, #48; see below for gloss level per application
   3. Galvanized Steel or Aluminum.
      a. Primer:
         1) Water Based MPI #134
      b. Topcoat, (2) coats:
         1) Alkyd, MPI #51, #47, #48; see below for gloss level per application.

D. Exterior:
   1. Masonry, Concrete walls, Typ.
      a. Primer:
         1) Block Filler MPI #4.
      b. Topcoat, (2) coats:
         1) Exterior Latex, MPI #10
   2. Non-galvanized Steel.
      a. Primer:
         1) Shop primed as specified
         2) Water-based Rust inhibitive primer, MPI #107

b. Topcoat, (2) coats:
1) HS Polyurethane Semi-Gloss, MPI #174

3. Galvanized Steel or Aluminum.
a. Primer:
1) Water Based MPI #134
b. Topcoat, (2) coats:
1) HS Polyurethane Semi-Gloss, MPI #174

2.04 PAINT FINISHES

A. Provide Paint finishes according to the types of surfaces applied to as follows, unless noted otherwise:
1. Ceilings/soffits: Flat
2. Food/Liquor spaces: Semi Gloss
3. Walls above wallcovering datum: Flat
4. Hollow metal doors: Semi-gloss
5. Painted wood: Satin enamel
6. Access Panels: Semi-gloss
7. Back of house, non public facing spaces: Semi-gloss.

B. Note: MPI numbers given in systems above refer to most typical conditions. In the event that those MPI numbers conflict with finishes here, select equivalent product in the gloss level indicated.

2.05 POWDER COATING

A. General: Provide powder coating systems by the Manufacturers and products as specified on the Powder Coating Schedule.

B. Exterior Applications:
1. Non-galvanized Steel
a. Polyester
2. Aluminum or Galvanized Steel
a. Fluoropolymer

C. Interior Applications:
1. Steel or Aluminum
a. Epoxy/Polyester blend

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
1. Concrete: 12 percent.
2. Gypsum Board: 12 percent.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.02 PREPARATION - PAINT

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" MPI (APSM) applicable to substrates indicated.

B. Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide

surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and re-prime substrate with compatible primers as required to produce paint systems indicated.

D. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.

E. Gypsum Board Substrates: Do not begin paint application until finishing compound is dry and sanded smooth.

3.03 APPLICATION - PAINT

A. Apply paints according to manufacturer's written instructions.

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable equipment, AV equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.04 APPLICATION - POWDER COATING

A. Perform coating and curing in shop according to Manufacturer's instructions and according to the methods of the PCI-PCCFH Handbook. Deliver parts with coating completed and in protective wrapping.

B. Inspect parts after installation for damage.

C. Touch-up damaged surfaces as recommended by Manufacturer.

D. Parts damaged in installation to an extent that acceptable touch ups and repairs cannot be performed shall be replaced at no cost to the Owner.

3.05 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.06 PAINT SCHEDULE

A. See Attached Schedule.

3.07 POWDER COATING SCHEDULE

A. See Attached Schedule.

END OF SECTION

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SECTION 09 91 01
PAINTING - SCHEDULES

PART 1 GENERAL

PART 2 PRODUCTS

PART 3 EXECUTION

3.01 PAINT SCHEDULE

A. PT-1
   1. Manufacturer: Benjamin Moore
   2. Color: OC-24 Winds Breath
   3. Finish: By Surface
   4. Location: General Ceiling, Soffits unless otherwise specified, Gyms Above AWC, Pools, Back of House (BOH), Exposed Ducts at Gyms, Access Panels, See Schedule.
   5. Notes: Color Preview Collection
   6. URL: https://www.benjaminmoore.com/en-us/color-overview/find-your-color/color/oc-24/winds-breath?color=OC-24

B. PT-2
   1. Manufacturer: Sherwin Williams
   2. Color: SW 7038 Tony Taupe
   3. Finish: By Surface
   4. Location: Door Frames, Exterior Metal-Door Frames, Bistro, Trash Enclosure, Access Panels; see schedule
   5. URL: https://www.sherwin-williams.com/homeowners/color/find-and-explore-colors/paint-colors-by-family/SW7038-tony-taupe

C. PT-3
   1. Manufacturer: Benjamin Moore
   2. Color: HC-110 Wethersfield Moss
   3. Finish: By Surface
   4. Location: Soffits at Café, Fitness Floor
   5. URL: https://www.benjaminmoore.com/en-us/color-overview/find-your-color/color/hc-110/wethersfield-moss?color=HC-110

D. PT-4
   1. Manufacturer: Sherwin Williams
   2. Color: SW 7037 Balanced Beige
   3. Finish: By Surface
   4. Location: Soffits at Salon, Spa Waiting, Yoga, Barre, Pilates, Cycle, Recovery, Access Panels; see schedule
   5. URL: https://www.sherwin-williams.com/homeowners/color/find-and-explore-colors/paint-colors-by-family/SW7037-balanced-beige

E. PT-5
   1. Manufacturer: Sherwin Williams
   2. Color: SW 0038 Library Pewter
   3. Finish: By Surface
   4. Location: See Drawings.
   5. URL: https://www.sherwin-williams.com/homeowners/color/find-and-explore-colors/paint-colors-by-family/SW0038-library-pewter

F. PT-6
   1. Manufacturer: Sherwin Williams
   2. Color: SW 7020 Black Fox
   3. Finish: By Surface
   4. Location: Door Frames at Spa, Yoga, Exterior Awning, Access Panels; see schedule

5. URL: https://www.sherwin-williams.com/homeowners/color/find-and-explore-colors/paint-colors-by-family/SW7020-black-fox

G. PT-7
1. Manufacturer: Sherwin-Williams.
2. Color: SW 6991 Black Magic
3. Finish: By Surface
4. Location: Desk Legs, Behind Mirrors, Pockets, Group Fitness Platform, Access Panels; see schedule
5. Notes: Macropoxy 646-100 – (2) Coats based on manufacturers recommendation at desk legs
6. URL: https://www.sherwin-williams.com/homeowners/color/find-and-explore-colors/paint-colors-by-family/SW6991-black-magic

H. PT-8
1. Manufacturer: Sherwin Williams
2. Color: SW 7642 Paverstone
3. Finish: By Surface
4. Location: Soffits at Coffee Lounge, Access Panels; see schedule.
5. URL: https://www.sherwin-williams.com/homeowners/color/find-and-explore-colors/paint-colors-by-family/SW7642-pavestone

I. PT-10
1. Manufacturer: Scuff master/Wolf Gordon
2. Color: WG 5854214
3. Finish: Solid Metal
4. Location: See drawings, Access Panels; see schedule

J. PT-12
1. Manufacturer: Sherwin Williams
2. Color: SW 7695 Mesa Tan
3. Finish: By Surface
4. Location: Pool IFS, Door frames at pools
5. URL: https://www.sherwin-williams.com/homeowners/color/find-and-explore-colors/paint-colors-by-family/SW7695-mesa-tan

K. PT-14
1. Manufacturer: Sherwin Williams
2. Color: SW 7036 Accessible Beige
3. Finish: By Surface
4. Location: Access Panels; see schedule
5. URL: https://www.sherwin-williams.com/homeowners/color/find-and-explore-colors/paint-colors-by-family/SW7036-accessible-beige

L. PT-15
1. Manufacturer: Sherwin Williams
2. Color: SW 6389 Butternut
3. Finish: By Surface
4. Location: Access Panels; see schedule
5. URL: https://www.sherwin-williams.com/homeowners/color/find-and-explore-colors/paint-colors-by-family/SW6389-butternut

M. PT-16
1. Manufacturer: Sherwin Williams
2. Color: SW 6347 Chrysanthemum
3. Finish: By Surface
4. Location: Access Panels; see schedule
5. URL: https://www.sherwin-williams.com/homeowners/color/find-and-explore-colors/paint-colors-by-family/SW6347-chrysanthemum

N. PT-17
   1. Manufacturer: Sherwin Williams
   2. Color: SW 6494 Lakeshore.
   3. Finish: By Surface.
   4. Location: Access Panels; see schedule
   5. URL: https://www.sherwin-williams.com/homeowners/color/find-and-explore-colors/paint-colors-by-family/SW6494-lakeshore

O. PT-18
   1. Manufacturer: Benjamin Moore
   2. Color: OC-61 White Diamond.
   3. Finish: By Surface.
   4. Location: White per drawings.
   5. URL: https://www.benjaminmoore.com/en-us/color-overview/find-your-color/color/oc-61/white-diamond?color=OC-61

P. PT-19
   1. Manufacturer: Sherwin Williams
   2. Color: SW 4084 Safety Yellow
   3. Finish: By Surface
   4. Location: Safety Yellow, Ramps / Exterior/ Sump Basin Lids and Covers
   5. URL: https://www.myperfectcolor.com/paint/75023-sherwin-williams-sw4084-safety-yellow

Q. PT-20
   1. Manufacturer: Benjamin Moore
   2. Color: HC-21 Huntington Beige.
   3. Finish: By Surface
   4. Location: Architectural Precast Spandrel / Cornice.
   5. URL: https://www.benjaminmoore.com/en-us/color-overview/find-your-color/color/HC-21/huntington-beige?color=HC-21

R. PT-22
   1. Manufacturer: Sherwin Williams
   2. Color: SW 6186 Dried Thyme
   3. Finish: By Surface
   4. Location: LT Work – Painted Millwork, Wood Panel Doors
   5. URL: https://www.sherwin-williams.com/homeowners/color/find-and-explore-colors/paint-colors-by-family/SW6186-dried-thyme

S. PT-23
   1. Manufacturer: Sherwin Williams
   2. Color: SW 7047 Porpoise
   3. Finish: By Surface
   4. Location: LT Work – Nook Ceiling, Group Studio Soffit, Access Panels; see schedule.
   5. URL: https://www.sherwin-williams.com/homeowners/color/find-and-explore-colors/paint-colors-by-family/SW7047-porpoise

T. PT-24
   1. Manufacturer: Sherwin Williams
   2. Color: SW 6187 Rosemary
   3. Finish: By Surface
   4. Location: LT Work – Restroom Ceiling, Access Panels; see schedule
   5. URL: https://www.sherwin-williams.com/homeowners/color/find-and-explore-colors/paint-colors-by-family/SW6187-rosemary

U. PT-25
   1. Manufacturer: Sherwin Williams
   2. Color: SW 7512 Pavilion Beige

3. Finish: By Surface
4. Location: LT Work – Conference Room, Access Panels; see schedule
5. URL: https://www.sherwin-williams.com/homeowners/color/find-and-explore-colors/paint-colors-by-family/SW7512-pavilion-beige

V. PT-26
1. Manufacturer: Sherwin Williams
2. Color: SW 7042 Shoji White
3. Finish: By Surface
4. Location: LT Work – Ceiling (Field)
5. URL: https://www.sherwin-williams.com/homeowners/color/find-and-explore-colors/paint-colors-by-family/SW7042-shoji-white

W. PT-27
1. Manufacturer: Sherwin Williams
2. Color: SW 6071 Popular Gray
3. Finish: By Surface
4. Location: LT Work – Office Walls, Access Panels, See Schedule
5. URL: https://www.sherwin-williams.com/homeowners/color/find-and-explore-colors/paint-colors-by-family/SW6071-popular-gray

X. PT-28
1. Manufacturer: Scuffmaster
2. Color: Envirometal Rolled EM8007R (brush and roll)
3. Finish: Brush and Roll.
4. Location: LT Work, See Drawings

Y. PT-28A
1. Manufacturer: Scuffmaster
2. Color by application:
   a. Spray: SM8150
   b. Brush and Roll: GOH 32067893/EM8150R
3. Finish: As indicated above.
4. Location: See Drawings

Z. PT-29
1. Manufacturer: Scuffmaster
2. Color: Solid Metal GOH 31664789
3. Finish: Solid Metal
4. Location: Stair Stringer, Riser and Handrail.

AA. PT-30
1. Manufacturer: Sherwin Williams
2. Color: Dull Orange, Custom Color to Match Pantone 158C
3. Finish: By Surface.
4. Notes: Custom Pantone 158C (Orange)
5. URL: https://www.pantone.com/color-finder/158-C

BB. PT-31
1. Manufacturer: Sherwin Williams
2. Color: Custom Color to Match Pantone 7C Gallon Color Cast
3. Finish: By Surface.
4. Notes: Custom Pantone 7C (Black)
5. URL: https://www.pantone.com/color-finder/black-7-C

CC. PT-32
1. Manufacturer: Sherwin Williams
2. Color: Custom Color to Match Pantone 2C Warm Gray

3. Finish: By Surface
4. Notes: Custom Pantone 2 (Gray)
5. URL: https://www.pantone.com/color-finder/Warm-Gray-2-C

DD. PT-33
1. Manufacturer: Sherwin Williams
2. Color: Custom Color to Match Pantone 7527
3. Finish: By Surface.
4. Notes: Custom Pantone 7527

EE. PT-34
1. Manufacturer: Sherwin Williams
2. Color: SW 7048 Urbane Bronze
3. Finish: By Surface.
4. Location: Access Panels; see schedule
5. URL: https://www.sherwin-williams.com/en-us/color/color-family/neutral-paint-colors/SW7048-urbane-bronze

FF. PT-35
1. Manufacturer: Sherwin Williams
2. Color: SW 7068 Grizzle Gray
3. Finish: By Surface.
4. Location: Access Panels; see schedule
5. URL: https://www.sherwin-williams.com/en-us/color/color-family/neutral-paint-colors/SW7068-grizzle-gray

GG. PT-37
1. Manfacturer: Benjamin Moore
2. Color: Antique Pewter 1560
3. Finish: By Surface.
4. Location: ceilings/soffits
5. URL: https://www.benjaminmoore.com/en-us/paint-colors/color/1560/antique-pewter

HH. PT-38
1. Manufacturer: Benjamin Moore
2. Color: Oak Grove 489
3. Finish: By Surface.
4. Location: Access Panels; see schedule
5. URL: https://www.benjaminmoore.com/en-us/paint-colors/color/489/oak-grove

II. PT-39
1. Manufacturer: Sherwin Williams
2. Color: SW 2809 Rookwood Shutter Green
3. Finish: By Surface.
4. Location: Pickleball
5. URL: https://www.sherwin-williams.com/en-us/color/color-family/green-paint-colors/SW2809-rookwood-shutter-green

JJ. PT-40
1. Manufacturer: Sherwin Williams
2. Color: SW 6839 Kimono Violet
3. Finish: By Surface.
4. Location: Access Panels; see schedule
5. URL: https://www.sherwin-williams.com/en-us/color/color-family/purple-paint-colors/SW6839-kimono-violet

KK. PT-42
1. Manufacturer: Sherwin Williams
2. Color: SW 6103 Tea Chest

3. Finish: By Surface.
4. Location: See drawings.
5. URL: https://protect-usb.mimecast.com/s/KehECQAr18H72Xv8FQABqI?domain=sherwin-williams.com

LL. PT-43
1. Manufacturer: Scuffmaster
2. Distributer: Wolf Gordon
3. Series: Solid Metal
4. Color: WG 7613613
5. Finish: Burnished Metallic
6. Location: See drawings.
7. URL: Custom color, no link.

MM. PT-44
1. Manufacturer: Sherwin Williams
2. Color: SW 9110 Malabar
3. Finish: By Surface.
4. Location: Access Panels; see schedule
5. URL: https://www.sherwin-williams.com/en-us/color/color-family/yellow-paint-colors/SW9110-malabar

NN. PT-45
1. Manufacturer: Sherwin Williams
2. Color: SW 6278 Cloak Gray
3. Finish: By Surface.
4. Location: Access Panels; see schedule
5. URL:https://www.sherwin-williams.com/en-us/color/color-family/purple-paint-colors/SW6278-cloak-gray

OO. PT-46
1. Manufacturer: Sherwin Williams
2. Color: SW 7649 Silverplate
3. Finish: By Surface.
4. Location: Access Panels; see schedule
5. https://www.sherwin-williams.com/en-us/color/color-family/neutral-paint-colors/SW7649-silverplate

PP. PT-47
1. Manufacturer: Scuffmaster
2. Color: BR10299
3. Finish: Burnished Metallic
4. Location: See drawings.
5. URL: https://www.scuffmaster.com/explore-colors/#?tags=BR10299

QQ. EPT-48
1. Manufacturer: Sherwin Williams
2. Color: SW7039 Virtual Taupe
3. Finish: Semi
4. Location: See drawings.
5. URL: https://www.sherwin-williams.com/en-us/color/color-family/neutral-paint-colors/SW7039-virtual-taupe

RR. EPT-49
1. Manufacturer: Sherwin Williams
2. Color: SW7506 Loggia
3. Finish: Semi-Gloss
4. Location: See drawings.

5. URL: https://www.sherwin-williams.com/en-us/color/color-family/neutral-paint-colors/SW7506-loggia

SS. EPT-50
1. Manufacturer: Sherwin Williams
2. Color: SW9174 Moth Wing
3. Finish: Semi-Gloss
4. Location: See drawings.
5. URL: https://www.sherwin-williams.com/en-us/color/color-family/neutral-paint-colors/SW9174-moth-wing

3.02 POWDER COATING SCHEDULE

A. PCC-13:
1. Manufacturer: Prismatic Powders
2. Product: PMB-1808
3. Color: Performance Gold
4. Location: Metal, See Drawings.
5. https://www.prismaticpowders.com/shop/powder-coating-colors/PMB-1808/performance-gold

B. PCC-14:
1. Manufacturer: Tiger Drylac
2. Product: 38/60080
3. Color: Statuary Bronze
4. Location: Metal, See Drawings.
5. URL: www.tiger-coatings.com/us-en/products/tiger-drylacr-products#/show/38-60080?gclid=Cj0KCQjw06OTBhC_ARIsAAU1yOVA5Cmya_7tAbGmcgcYQYHgzcHlF3ywkCc8O_EKTqWJkKBTtr4tTRsaAskgEALw_wc

C. PCC-16:
1. Manufacturer: Prismatic Powders
2. Product: PMB-2749 / Metallic
3. Color: Black Bronze II
4. Location: Metal, See Drawings. Matches Dark Bronze hardware
5. URL: https://www.prismaticpowders.com/shop/powder-coating-colors/PMB-2749/black-bronze-ii

D. PCC-17:
1. Manufacturer: Sherwin Williams
2. Product: Powdura Polyester TGIC Powder Coating
3. Product #: PDS4-C0014
4. Color: Architectural Bronze
5. Location(s): Site Fencing, Trash Enclosure Gate

3.03 SCHEDULE OF PAINT COLORS FOR ACCESS PANELS BY WALL FINISH

A. Tile:
1. TL-9: PT-27
2. TL-13: PT-1
3. TL-14: PT-14
4. TL-15: PT-6
5. TL-22: PT-4
6. TL-23: PT-5
7. TL-24: PT-1
8. TL-51: PT-14
9. TL-52: PT-2
10. TL-53: PT-5
11. TL-54: PT-7
12. TL-55: PT-23
13. TL-61: PT-4

14. TL-62: PT-35
15. TL-77: PT-14

B. Wall Coverings:
1. WC-1: PT-2
2. WC-3: PT-44
3. WC-4A: >1 sq. ft.= PT-28A, <1 sq. ft. = PT-25
4. WC-4B: >1 sq. ft. = PT-10, <1 sq. ft. = PT-8
5. WC-4C: PT-4
6. WC-5A: PT-4
7. WC-5B: PT-23
8. WC-6A: PT-7
9. WC-6B: PT-8
10. WC-7: PT-45
11. WC-8A: PT-15
12. WC-8B: PT-16
13. WC-8C: PT-17
14. WC-9: PT-23
15. WC-11A: PT-25
16. WC-11B: PT-45
17. WC-12: PT-23
18. WC-13A: PT-1
19. WC-15: PT-25
20. WC-16: PT-24
21. WC-17: PT-8
22. WC-19: PT-8
23. WC-23: PT-46
24. WC-26: PT-1
25. WC-27: PT-27

3.04 SCHEDULE OF FACEPLATE AND WIRING DEVICES COLORS BY WALL FINISH:

A. White faceplates are to be used on walls with the following finishes:
1. PT-1
2. PT-4
3. PT-14
4. PT-18
5. PT-25
6. PT-26
7. PT-27
8. PT-44
9. PT-46

B. All other faceplates and wiring devices installed on painted walls are to be black.

END OF SECTION

SECTION 10 14 00
SIGNAGE

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Exterior Signage.
   2. Interior Signage.

1.02 RELATED SECTIONS

A. Section 01 33 00 - Submittal Procedures.

B. Section 01 40 00 - Quality Requirements.

C. Section 01 60 00 - Product Requirements.

D. Section 03 30 00 - Cast-in-Place Concrete.

E. Section 04 20 00 - Unit Masonry.

F. Section 05 50 00 - Metal Fabrications.

G. Section 07 24 00 - Exterior Insulation and Finish System.

H. Section 07 92 00 - Joint Sealants.

I. Section 09 91 00 - Painting.

1.03 REFERENCES

A. Standards of the following as referenced:
   1. Aluminum Association (AA)
   2. Americans with Disabilities Act Accessibility Guidelines (ADAAG)
   3. American National Standards Institute (ANSI)
   4. American Society for Testing and Materials (ASTM)
   5. Manual on Uniform Traffic Control Devices (MUTCD)
   6. Underwriters' Laboratories, Inc. (UL)

1.04 SUBMITTALS

A. Product data: for each type of sign specified, including details of construction relative to materials, dimensions of individual components, profiles and finishes.

B. Shop drawings: identifying all materials, sizes, construction details, graphics layout, type style specifications and mounting methods showing fabrication and attachment of signs. Include plans, elevations and large-scale sections of typical members and other components. Show anchors, grounds, layout, reinforcement, accessories and installation details.
   1. Templates: Furnish full-size spacing templates for individually mounted dimensional letters and numbers.
   2. For signs supported by or anchored to permanent construction, provide setting drawings, templates and directions for installation of anchor bolts and other anchors to be installed as a unit of Work in other Sections.
   3. If required by the state, all exterior signage anchorage to be designed by a professional engineer registered by the state. Submit signed and sealed anchor details to architect for approval.
   4. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication to ensure proper fitting. Show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay.

C. Signage Schedule: Complete with the location of each sign and the required copy/text.

D. Wiring diagrams from the manufacturer for illuminated sign units must be submitted to for approval. Include the following:
   1. Proposed LED configuration and layout within each letter and cabinet.
   2. Quantity of modules per letter and cabinet.

3. Power supply quantities, locations and loads.

E. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.
   3. See Sections 01 33 00 and 01 60 00.

1.05 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Sign Fabricator Qualifications: Firm experienced in producing signs similar to those required for this Project, with a record of successful in-service performance and sufficient production capacity to produce sign units without causing delay in the Work.

C. UL and NEMA Compliance: Provide sign lighting fixtures and electrical components for illuminated signs that are labeled and listed by UL and comply with applicable NEMA standards.

D. Single-Source Responsibility: For each separate sign type required, obtain signs from one source of a single manufacturer.

1.06 PERFORMANCE REQUIREMENTS

A. Provide signage that conforms to the requirements of regulatory agencies holding jurisdiction.

B. Products shall meet the current requirements of the Americans with Disabilities Act Accessibility Guidelines (ADAAG) and local amendments and modifications. All signage to comply with ADAAG provisions for signage, at appropriate locations, with respect to the following:
   1. Character proportion.
   2. Character height.
   3. Raised and braille characters.
   4. Pictorial symbols.
   5. Finish and contrast.

1.07 DELIVERY, STORAGE AND HANDLING

A. Comply with requirements of Division 1.

B. Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.

C. Deliver products in manufacturer's original, unopened, undamaged containers with identification labels intact.

D. Store products protected from weather, temperature, and other harmful conditions as recommended by supplier.

E. Handle products in accordance with manufacturer's instructions.

1.08 WARRANTY

A. Project Warranty: Comply with requirements of Division 1.

B. Manufacturer's Warranty: Submit manufacturer's standard warranty document executed by authorized company official.
   1. Warranty Period:
      a. LEDs: 5 year parts and labor warranty.
      b. LED power supplies: 5 year parts and labor warranty.

PART 2 PRODUCTS

2.01 SIGN MATERIALS: DRIVEWAYS, PARKING LOTS AND RAMPS

A. Manufacturers: Subject to compliance with requirements, provide products as specified and shown on drawings.

B. Traffic Control Signage: All traffic control signs must comply with the latest requirements per MUTCD. See Civil drawings for schedules, locations and details.

2.02 SIGN MATERIALS: MONUMENT, EXTERIOR BUILDING FACADES & POOL AREAS

A. Manufacturers: Subject to compliance with requirements, provide products as specified and shown on drawings.

B. Halo-Illuminated Channel Letters – LIFE TIME Sign.
   1. Letter Type: Reverse pan channels with halo illumination.
   2. Interior of channel letters shall be painted white or coated with reflective 3M film.
   3. Depth: 3” or as shown on drawings.
   4. Faces:
      a. “LIFE” = .090” Aluminum w/80 grit vertical brushed finish.
      b. “TIME” = .090” Aluminum w/80 grit vertical brushed finish.
   5. Backs: .150” clear Lexan w/riveted angle clips for face/return attachment.
   6. Returns: .090” Aluminum.
   7. Color: Shine seal finish.
   8. Mounting: Mount to exterior substrate with 2” spacers and anchors as required.
   9. Illumination: White LEDs:
      a. Manufacturers:
         1) Samsung.
         2) GE.
         3) Principal.
         4) Approved equivalent.
      b. LED requirements:
         1) Color Temp: 7,000K.
         2) Wet location rated.
         3) (3) LEDs per module.
         4) Minimum 90 lumens per foot or as required to provide adequate illumination. Illumination determined based on size of object and reflectance of supporting wall.
   10. Power: Power supplies to be dual rated for 120/277V and not be loaded more than 75% of the rated power supply capacity. Provide integral disconnect switch accessible to technician without entering cabinet.

C. Halo-Illuminated Channel Letters - LIFE CAFÉ & LIFE SPA Signs.
   1. Letter Type: Reverse pan channels with halo illumination.
   2. Interior of channel letters shall be painted white or coated with reflective 3M film.
   3. Depth: 2” or as shown on drawings.
   4. Faces:
      a. “LIFE” = .090” Aluminum w/80 grit vertical brushed finish.
      b. “CAFE” & “SPA”= .090” Aluminum w/80 grit vertical brushed finish.
   5. Backs: .150” clear Lexan w/riveted angle clips for face/return attachment Returns: .063” aluminum.
   6. Returns: .090” Aluminum.
   7. Color: Shine seal finish.
   8. Mounting: Mount to substrate with 2” spacers and anchors as required.
   9. Illumination: White LEDs:
      a. Manufacturers:
         1) Samsung.
         2) GE.
         3) Principal.
         4) Approved equivalent.
      b. LED requirements:
         1) Color Temp: 7,000K.

2) Wet location rated.
3) (3) LEDs per module.
4) Minimum 90 lumens per foot or as required to provide adequate illumination. Illumination determined based on size of object and reflectance of supporting wall.

10. Power: Power supplies to be dual rated for 120/277V and not be loaded more than 75% of the rated power supply capacity. Provide integral disconnect switch accessible to technician without entering cabinet.

D. Illuminated LOGO – LIFE CAFÉ & LIFE SPA Signs.
1. Cabinet: Lighted Box Cabinet.
2. Depth: 2” or as shown on drawings.
3. Face: 3/16” translucent white acrylic.
4. Back: .063” aluminum w/riveted angle clips for face/return attachments.
5. Returns: .063” aluminum.
6. Logo: 3/16” flat cut-out aluminum, painted P.T.M. MAP “Black.”
7. Color (returns): P.T.M. MAP “Black.”
8. Illumination: Internal White LEDs:
   a. Manufacturers:
      1) Samsung.
      2) GE.
      3) Principal.
      4) Approved equivalent.
   b. LED requirements:
      1) Color Temp: 7,000K.
      2) Wet location rated.
      3) (3) LEDs per module.
      4) Minimum 90 lumens per foot or as required to provide adequate illumination. Illumination determined based on size of object and reflectance of supporting wall.
9. Power: Power supplies to be dual rated for 120/277V and not be loaded more than 75% of the rated power supply capacity. Provide integral disconnect switch accessible to technician without entering cabinet.
10. Mounting: Mount to substrate as required and shield fasteners though frame stand-offs as required. Provide galvanized screws as required at exterior substrates.

E. Halo illuminated Channel Letters: LIFE TIME PICKLEBALL.
1. Letter Type: Reverse pan channels with halo illumination.
2. Interior of channel letters shall be painted white or coated with reflective 3M film.
3. Depth: 3” or as shown on drawings.
4. Stand offs: 2" min from face of wall to back of letter.
5. Faces:
   a. “LIFE TIME” = .125” Anodized Aluminum w/80 grit vertical brushed finish and clear coat.
   b. “Pickleball” and Logo = .125” Anodized Aluminum w/80 grit vertical brushed finish painted to match Pantone PMS 2995 Blue.
6. Returns:
   a. .080 x 3" Anodized Aluminum. Finish to match face.
7. Backs: .150” clear Lexan w/riveted angle clips for face/return attachment Returns: .063” aluminum.
8. Illumination: Internal White LEDs:
   a. Manufacturers:
      1) Samsung.
      2) GE.
      3) Principal.
      4) Approved equivalent.
   b. LED requirements:

1) Color Temp: 7,000K.
2) Wet location rated.
3) Minimum 90 lumens per foot or as required to provide adequate illumination. Illumination determined based on size of object and reflectance of supporting wall.

9. Power: Power supplies to be dual rated for 120/277V and not be loaded more than 75% of the rated power supply capacity. Provide integral disconnect switch accessible to technician without entering cabinet.
10. Mounting: Mount to substrate as required and shield fasteners though frame stand-offs as required. Provide galvanized screws as required at exterior substrates.

F. Address: Non-Illuminated Address F.C.O.
1. Type: Flat cut-out.
2. Faces: ¼" aluminum w/80 grit vertical brushed finish on faces.
3. Returns: ¼" aluminum with natural aluminum finish.
4. Numbers: As shown on drawings and/or as provided by owner.
5. Color: Shine seal finish.
6. Illumination: Non-illuminated.
7. Mounting: Mount flush to wall substrate with ¼" x 4" studs and Hilti injectable mortar as required.

2.03 SIGN MATERIALS: INTERIOR

A. Interior signage to be furnished and installed by Owner or by Manufacturer of related equipment.
1. Contractor to coordinate blocking, electrical, and other requirements.

B. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signage, noncorrosive and compatible with each material joined, and complying with the following:
1. Use concealed fasteners and anchors unless indicated to be exposed.
2. For exterior exposure, furnish hot-dip galvanized devices unless otherwise indicated.
3. Sign Mounting Fasteners:
a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material or screwed into back of sign assembly, unless otherwise indicated.
4. Inserts: Furnish inserts to be set by other trades into concrete or masonry work.

C. Adhesives: As recommended by sign manufacturer and with a VOC content of 70 g/L or less for adhesives used inside the weatherproofing system and applied on-site when calculated per 40 CFR 59, Subpart D (EPA Method 24).

2.04 FINISHES

A. Colors and Surface Textures: For exposed sign that require selection of materials with integral or applied colors, surface textures, or other characteristics related to appearance, provide color matches indicated or if not indicated, as selected by Owner from manufacturer's full standard color range.

B. Metal Finishes: Comply with NAAMM "Metal Finishes Manual" for finish designations and applications recommendations.

C. Aluminum Finishes: Finish designations prefixed by "AA" conform to the system established by the Aluminum Association for designating aluminum finishes.
1. Class II Clear Anodized Fine Satin Finish: AA-M31C21A31 (Mechanical Finish: Fine satin directional textured; Chemical Finish: Fine matte etched finish; Anodic Coating: Class II Architectural, clear film thicker than 0.4 mil).

PART 3 EXECUTION

3.01 EXAMINATION

A. Site Verification of Conditions: Verify installation conditions previously established under other sections are acceptable for product installation in accordance with manufacturer's instructions including for correct location of cast-in anchor installed under other section.

B. Notify Architect in writing of unacceptable substrate or improper anchor location(s).

C. Scheduling of installation by Owner or it's representative implies that substrate and conditions are prepared and ready for product installation. Proceeding with installation implies installer's acceptance of substrate and acceptance of substrate and conditions.

3.02 INSTALLATION

A. Locate sign units and accessories where indicated, using mounting methods of the type described and in compliance with the manufacturer's instructions.
   a. Install product level, plumb, and at heights indicated.
   b. Install product at heights to conform to Americans with Disabilities Act Accessibility Guidelines (ADAAG) and applicable local amendments and regulations.
   c. Install signs within the following tolerances and in accordance with manufacturer's recommendations:
      1) Interior Signs: Within 1/4 inch vertically and horizontally of intended location.

B. Halo - Illuminated Signs.
   1. Channel letters:
      a. Reverse pan channel letters with halo illumination.
      b. LED modules to wrap letters in continuous rows approximately 1.5" off edge; spacing to be approximately 3" on center between modules; closer as required to achieve uniform halo.
      c. Mount to clear lexan back pointed toward letter front to allow for double bounce of light.
      d. Install reflective backing on wall of building behind each letter.
   2. Cabinet:
      a. Reverse pan channel cabinet with halo illumination and face illuminated text graphics.
      b. LED modules to run in straight line, parallel with top and bottom of cabinet, spacing to be approximately 3" on center between modules and 6" on center between rows. Spacing should be modified as needed to achieve uniform illumination.

C. Wall-Mounted Panel Signs: Attach panel signs to wall surfaces using the methods indicated below:
   1. Silicone-Adhesive Mounting: Use liquid silicone adhesive recommended by the sign manufacturer to attach sign units to irregular, porous or vinyl-covered surfaces. Use double-sided vinyl tape where recommended by the sign manufacturer to hold the sign in place until the adhesive has fully cured.
   2. Shim Plate Mounting: Provide 1/8-inch-thick concealed aluminum shim plates with predrilled and countersunk holes, where other mounting methods are not practicable. Attach the plate with fasteners and anchors suitable for secure attachment to the substrate. Attach panel sign units to the plate using the method specified above.

D. Bracket-Mounted Units: Provide the manufacturer's standard brackets, fittings and hardware as appropriate for mounting signs that project from walls and ceilings. Attach brackets and fittings securely to walls or ceilings with concealed fasteners and anchoring devices to comply with manufacturer's directions.

E. Cast Metal Plaques: Mount plaques using the standard method recommended by the manufacturer for the type of wall surface indicated.
   1. Concealed Mounting: Mount the plaques by inserting threaded studs into tapped lugs on the back of the plaque. Set in predrilled holes filled with quick-setting cement.
   2. Face Mounting: Mount plaques using exposed fasteners with rosettes attached through the face of the plaque into the wall surface.

3.03 CLEANING, PROTECTION AND REPAIR

A. Repair scratches and other damage which might have occurred during installation. Replace components where repairs were made but are still visible to the unaided eye from a distance of 3 feet.

B. After installation, clean sign surfaces according to the manufacturer's instructions. Protect units from damage until acceptance by Owner.

C. Remove temporary coverings and protection to adjacent work areas. Clean installed products in accordance with manufacturer's instructions prior to Owner's acceptance. Remove construction debris from project in accordance with provisions in Division 1.

3.04 SIGN SCHEDULE

A. Exterior Signs: Refer to drawings, including civil, for sizes, locations, and layout of signage types, sign text copy, and graphics.

B. Interior Signs: Refer to signage phasing schedules and drawings for sizes, locations, and layout of signage types, sign text copy, and graphics.

END OF SECTION

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SECTION 10 21 13.16
PLASTIC-LAMINATE-CLAD TOILET COMPARTMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Plastic laminate toilet compartments.

B. Plastic laminate doors for changing rooms.

C. Plastic laminate Urinal screens.

1.02 RELATED REQUIREMENTS

A. Section 01 33 00 - Submittal Procedures.

B. Section 01 40 00 - Quality Requirements.

C. Section 01 60 00 - Product Requirements.

D. Section 05 12 00 - Structural Steel Framing: Concealed steel support members.

E. Section 05 50 00 - Metal Fabrications: Concealed steel support members.

F. Section 06 10 00 - Rough Carpentry: Blocking and supports.

G. Section 09 30 00 - Tiling: Adjacent Surfaces

H. Section 10 28 13 - Toilet and Bath Accessories.

1.03 REFERENCE STANDARDS

A. ANSI A208.1 - American National Standard for Particleboard; 2022.

B. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.

C. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate the work with placement of support framing and anchors in walls and ceilings.

1.05 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00.

1.06 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall supports, door swings.

C. Product Data: Provide data on panel construction, hardware, and accessories.

D. Manufacturer's Installation Instructions: Indicate special procedures.

E. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.
   3. See Sections 01 33 00 and 01 60 00.

1.07 WARRANTY

A. Provide Manufacturer's standard three-year warranty.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Plastic Laminate Toilet Compartments:
   1. ASI Accurate Partitions; Legacy Plastic Laminate. www.asi-accuratepartitions.com/#sle.

2. Substitutions: Not permitted.

2.02 MATERIALS

A. Particleboard for Core: ANSI A208.1 composed of wood chips, sawdust or flakes, made with waterproof resin binder; 45 lb density, 7/8" thick; sanded faces.
   1. All components shall be edge banded prior to face lamination.

B. Plastic Laminate: NEMA LD 3, HGS. .50 Thickness decorative, vertical grade laminate.
   1. PLAM-19. See Section 06 40 00 - Architectural Woodwork for more information.
   2. Substitutions: Not permitted.

C. Adhesive: non-toxic, water resistant type.

2.03 COMPONENTS

A. Toilet Compartments: Plastic laminate finished, floor-mounted headrail-braced.

B. Doors, Panels, and Pilasters: Plastic laminate adhesive and pressure bonded to faces and edges of particleboard core, with beveled corners and edges; edges of cut-outs sealed.
   1. Plastic Laminate Color: Plastic Laminate Finish: PLAM-19, unless noted otherwise. See section 06 40 00 – Architectural Woodwork for PLAM schedule.

C. Door and Panel Dimensions:
   1. Thickness: 1 inch (25 mm).
   2. See Drawings for size.

D. Urinal Screens: Wall mounted with two panel brackets.

2.04 ACCESSORIES

A. Pilaster Shoes: Formed chromed steel with polished finish, 3 inches (75 mm) high, concealing floor fastenings.

B. Head Rails: Hollow anodized aluminum tube, size by manufacturer, with anti-grip strips and cast socket wall brackets.

C. Wall and Pilaster Brackets: Polished stainless steel.

D. Attachments, Screws, and Bolts: Stainless steel, tamper proof type.
   1. For attaching panels and pilasters to brackets: Through-bolts and nuts; tamper proof.

E. Steel Plate Reinforcement: Carbon steel, prepared for fasteners, 1/8 inch (3 mm) thick.

F. Hardware: Manufacturer's standard heavy duty hardware. Polished stainless steel.
   1. Pivot hinges, gravity type, adjustable for door close positioning; two per door.
   2. Thumb turn door latch with exterior emergency access feature. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.
   3. Door strike and keeper with rubber bumper; mounted on pilaster in alignment with door latch.
   4. Coat hook with rubber bumper; one per compartment, mounted on door. Omit at Life Time Kids' Academy (LTKA) and replace with wall mounted stop, Jacknob 4123 or eq.
   5. Provide door pull for outswinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify correct spacing of and between plumbing fixtures.

C. Verify correct location of built-in framing, anchorage, and bracing.

3.02 INSTALLATION

A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.

B. Maintain 3/8 to 1/2 inch (9 to 13 mm) space between wall and panels and between wall and end pilasters.

C. Attach panel brackets securely to walls using anchor devices.

D. Attach panels and pilasters to brackets. Locate head rail joints at pilaster center lines.

E. Field touch-up of scratches or damaged finish will not be permitted. Replace damaged or scratched materials with new materials.

3.03 ADJUSTING

A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch (5 mm).

B. Adjust hinges to position doors in full closed position when unlatched. Return out-swinging doors to closed position.

C. Adjust adjacent components for consistency of line or plane.

END OF SECTION

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SECTION 10 22 36
COILED WIRE FABRIC AND ATTACHMENT SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Coiled Wire Fabric and Attachment Systems.

1.02 RELATED SECTIONS

A. Section 01 33 00 - Submittal Procedures.

B. Section 01 40 00 - Quality Requirements.

C. Section 01 60 00 - Product Requirements.

D. Section 05 50 00 - Metal Fabrications.

E. Section 06 10 00 - Rough Carpentry.

F. Section 08 71 00 - Door Hardware.

G. Section 09 21 16 - Gypsum Board Assemblies.

1.03 REFERENCES

A. American Iron and Steel Institute (AISI) - Steel Product Manual; Stainless and Heat Resisting Steel.

B. ASTM A380/A380M - Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems; 2017.

C. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).

D. AWS D1.6/D1.6M - Structural Welding Code - Stainless Steel; 2017, with Amendment (2021).

E. MIL-C-5688 - Pre-Stretching and Proof-Testing of Wire Rope Assemblies.

1.04 DEFINITIONS

A. Coiled Wire Fabric: A building material manufactured by Cascade Coil Drapery. The material is created by interlocking strands of coiled wire to form a larger flexible sheet. Coiled wire fabric is made from a variety of metals and gauges of wire, and in a wide variety of scales.

B. Attachment Systems: Component materials required to present Coiled Wire Fabric in a specified manner (i.e., tensioned flat in two directions, tensioned in two directions with a percentage of fullness, tensioned flat in four directions, hanging in one direction, wrapping a form, etc.), for connecting it to the built environment and for attaining a specified performance capability. Engineered attachments may allow Coiled Wire Fabric panels to remain in a static position or to move, either manually or mechanically.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Pre-Submittal Hardware and Keying Meeting: Prior to preparing final submittals, conduct meeting including Owner, Architect, and supplier of hardware to determine the following:
   1. Lock Function: Demonstrate function/type of each lockset scheduled and verify function at each door.
   2. Electrical Operation: Verify function of openings requiring electrified hardware.
   3. Keying: Determine keying requirements for preparation of final keying schedule.
   4. Submit letter of compliance, indicating when this meeting was held and who was in attendance, to Architect, Owner, and hardware supplier.

1.06 DESIGN / PERFORMANCE REQUIREMENTS

A. Structural Requirements: Provide coiled wire fabric systems capable of withstanding the effects of gravity and applied loads and stresses within limits and under conditions indicated on the Drawings:
   1. Components: Design and size to withstand dead and live loads of components, vegetation, rain, snow and ice and loads caused by positive and negative wind pressure acting normal to plane of the coiled wire fabric as calculated in accordance with applicable code.

B. Coiled Wire Fabric systems shall accommodate expansion and contraction of metal components without causing undue stress, buckling, opening of joints, and distortion.

C. Supports and hardware shall withstand loads encountered without excessive deflection or distortion when cables are tensioned to required amounts required to conform to applicable building codes.

1.07 SUBMITTALS

A. Submit under provisions of Section 01 33 00 - Submittal Procedures.
   1. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
   2. Shop Drawings: For fabrication and installation. Include plans, elevations, sections, details, and attachments to other work.
      a. Indicate materials, methods, finishes, fittings, hardware, anchorage, and accessory items.
      b. Provide setting diagrams and templates for anchorages and hardware to be installed by others.
      c. Where materials or fabrications are indicated to comply with design loadings, include material and safety factor properties, and other information need for structural analysis.
   3. Structural Calculations: Submit manufacturer’s design data, including structural calculations prepared by a qualified professional engineer.
   4. Samples for Verification:
      a. Submit samples for initial color selection of each specified finish.
      b. Sample size of coiled wire fabric to be 6 in. wide by 10 in. long.
   5. Certificates: 1 mill certificates signed by manufacturers of wire products certifying that products furnished comply with requirements.

1.08 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Installer Qualifications: Company experienced in manufacturer's products, or similar, for a minimum of 5 years. The Contractor shall provide trained laborers with prior experience in the type of construction involved as well as experience installing the materials and techniques specified.

C. Qualified Professional Engineer: A professional engineer licensed in the state of the Project location and who is qualified to design the portion of the work described in this Section.

D. Pre-installation Meetings: Conduct meetings including Contractor, Architect, fabricator, installer and other subcontractors whose work involves Coiled Wire Fabric to verify project requirements, framing and support conditions, mounting surfaces and manufacturer's installation. Comply with Division 1 requirements.

E. Product Options:
   1. Information on the Drawings and in the specifications, establishes requirements for system's aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, profiles of components, and assemblies as they relate to sightlines, to one another, and adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including structural analysis, preconstruction testing, field-testing, and in-service performance.
   2. The Drawings indicate size, profiles, and dimensional requirements of Coiled Wire Fabric Systems and are based on the specific system indicated. Refer to Section 01 60 00 - Product Requirements.

F. Modifications: Do not modify intended aesthetic effects as judged solely by the Architect, expect with the Architect's approval. If modifications are proposed, submit comprehensive explanatory data to the Architect for review.

G. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M and AWS D1.6/D1.6M.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Handle and store products according to manufacturer's recommendations. Leave products wrapped or otherwise protected and under clean and dry storage conditions until required for installation.

C. Exercise care not to scratch, mark, dent, or bend metal components during delivery, storage, and installation.

D. Store Material within limits of for temperature and humidity recommended by manufacturer.

1.10 PROJECT CONDITIONS

A. Verify actual openings by field measurements before fabrication; show recorded measurements on shop drawings.

1.11 COORDINATION AND SCHEDULING

A. Coordinate field measurements and fabrication schedule with construction progress to avoid construction delays.

1.12 WARRANTY

A. Manufacturer’s standard limited warranty for materials and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide Coiled Wire Fabrics and Coiled Wire Fabric Attachment Systems as indicated on the Drawings. Manufacturer/Contractor shall engineer and fabricate components and assemblies for installation.

B. Manufacturer:
   1. Basis of Design: Cascade Coil Drapery, Inc., PO Box 3707, 19505 SW 90th Ct.; Tualatin, OR 97062; Contact: Andrew Schoenheit Toll Free Tel: 800-999-2645; Tel: 281-771-3339; Fax: 971-224-2199; Email: (request info (andrew@cascadecoil.com); Web: www.cascadecoil.com, www.cascadearchitectural.com, http://www.fabricoil.com

C. Substitutions: In accordance with Division 1 Requirements.

2.02 COILED WIRE FABRIC SYSTEMS

A. Provide Coiled Wire Fabrics and Coiled Wire Fabric Attachment Systems as indicated on the Drawings. Manufacturer/Contractor shall engineer and fabricate components and assemblies for installation.

B. CWF-3: Security Screen
   1. Coiled Wire Fabric.
      a. Material – Aluminum.
      b. Panel Depth – 5/16”.
      c. Wire Gauge – 14GA.
      d. Finish – Metaltone Finish – Powder Coated Antique Bronze.
      e. Fullness – As required.
   2. Attachment Systems - Secura Double Track System for Coiled Wire Fabrics - Direct Mount.
      a. Material – Galvanized Steel.
      b. System Type - (2) #4511S
      c. Finish – Powder coated to Match Fabric.
   3. Guardian Coil Semi Security Gate Systems: Guardian Coil Security Hardware
      a. Double 90-degree (All Track Curves to be 24” Minimum Radius)
      b. Material - Galvanized Steel.
      c. Configuration – The system is to utilize V103, V107 and V111 Channels with S525 Positive Locking Mesh Mount Foot bolt on Secured Side Only.
      d. Fabric Fasteners, hooks and double bolt guardian grade trolley carriers.
      e. Connector Type: #4518-G1B Nylon Carrier w/ hardware staggered @ 7” O.C. Typ.
      f. Receiver Socket for S525 Footbolt to be countersunk into floor and slab and to be flush with finished floor.
      g. Baton - (BT0500XX-S – size dependent on gate height)

1) Material - Stainless Steel.
2) Finish - Powder coated to match fabric.

4. Keying/Locking Device.
   a. Keyed - Unsecured Side, Thumb Turn - Secured Side.
   b. L215 Handle Both Sides.
   c. L200SCH Schlage Lock Assembly.
   d. Schlage Primus Core 20-740-6 pin.
   e. Schlage Mortise Housing PN 20-060626-IC.
   f. Schlage Control Key for Primus core 20-740.
   g. Powder coat finish to match coil system.
   h. Metal Components shall be factory-finished.

C. CWF-4: Fixed Divider Drapery
   1. Product: Fabricoil - Coiled Wire Fabric as manufactured by Cascade Coil Drapery.
      a. Material - Fabricoil Type Bright Basic Steel.
      b. Panel Depth - 3/16".
      c. Fullness - 200%
      d. Wire Gauge - 19GA.
      e. Finish - Metatone Finish - Powder coated Antique Bronze.
   2. Attachment Systems: Steel angle.
      a. Product: 4592 S-Hooks and 1/8” Steel mounting angle directly mounted to substrate.
      b. Material – Steel.
      c. Finish – Metatone Finish – Powder coated Antique Bronze.

2.03 FABRICATION

A. Tolerances: Verify dimensions on site prior to shop fabrication.

B. Fabricate steel and stainless steel in accordance with AISI Steel Product Manual and the manufacturer's requirements.

C. Welded connections shall comply with AWS standards for recommended practice in shop welding. Welds behind finished surfaces shall be without distortion or discoloration of exposed side.

D. Components shall be accurately cut, drilled and/or tapped to receive coiled wire fabric, hardware, fasteners, and accessories.

E. Shop fabricate to designs indicated on Drawings and to meet performance requirements specified. Shop fabricate hardware, interfacing parts and assemblies so that field cutting adjustments are not necessary.

F. Coordinate requirements, dimensions and spacing of attachment systems to ensure required factory drilled holes in supporting framework are correctly located.

G. Make exposed joints butt, flush, and hairline.

H. Fabricate connections that will be exposed to weather in a manner to exclude water, per Architect.

2.04 FINISH

A. After fabrication and/or weaving, clean and prepare Coiled Wire Fabric System in accordance with ASTM A380/A380M, if applicable.

PART 3 EXECUTION

3.01 EXAMINATION

A. Before beginning installation, verify that conditions installed under other sections are acceptable for installation of Coiled Wire Fabric and Attachment Systems in accordance with manufacturer's installation instructions.

B. Coordinate setting diagrams, plans, templates, and drawings and verify the proper installation of any necessary anchorages as detailed in the Drawings.

C. Verify supporting system for Coiled Wire Fabric is prepared for attachment of framework, hardware, anchors and wire rope and transfer of calculated loads.

D. If conditions are the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

E. Coordinate with appropriate entity to correct unsatisfactory conditions, if any exist.

F. Beginning of the work shall indicate acceptance of the areas and conditions as satisfactory by the Installer.

3.02 PREPARATION

A. Installer to verify inventory components to ensure all required items are available for installation. Inspect components for damage. Remove damaged components from site and replace.

B. Contractor shall verify alignment, support dimensions, and tolerances are correct.

C. Contactor shall verify all necessary framework and blocking is installed prior to mounting Coiled Wire Fabric Attachment Systems to existing structure.

3.03 INSTALLATION

A. Coiled Wire Fabric:
   1. Install Coiled Wire Fabric in accordance with the approved shop drawings.
   2. Assemblies shall be installed based on manufacturer's dimensions and specifications.
   3. Joints shall accommodate expansion and contraction of metal components without causing undue stress, buckling, joint fatigue and/or distortion. Follow manufacturer's installation.
   4. Install manufacturer-supplied brackets and mounting hardware onto Coiled Wire Fabric as indicated in shop drawings for specific Coiled Wire Fabric Attachment Systems. Attach with approved fasteners and techniques to ensure that sections are horizontal and parallel to grade/slab or rake to within 1/16 inch (1.58 mm) in 4 feet (1.2 m).
   5. Verify that support framing and other surfaces to receive Coiled Wire Fabric are clean and free of obstructions.
   6. Follow shop drawings to attach Coiled Wire Fabric to support framing using appropriate manufacturer supplied hardware.
   7. Provide anchorage devices and fittings to secure to in-place construction; including additional frame work, blocking, threaded rods and anchors.
   8. Install infill plumb, level, square, and rigid without kinks or sags.
   9. Anchor Coiled Wire Fabric and Attachment Systems to mounting surfaces as indicated on the Drawings.
   10. Separate dissimilar materials with bushings, grommets, or washers to prevent electrolytic corrosion.
   11. Use manufacturer's supplied hardware.
   12. Tension Coiled Wire Fabric per drawings, or as necessary, so that no slack is visible.
   13. After final adjustment provide tamper resistant lock tight materials on all fittings.

B. Coiled Wire Fabric Attachment Systems:
   1. Install Coiled Wire Fabric Attachment Systems in accordance with the approved shop drawings.
   2. Assemblies shall be installed based on manufacturer's dimensions and specifications.
   3. Joints shall accommodate expansion and contraction of metal components without causing undue stress, buckling, joint fatigue and/or distortion. Follow manufacturer's installation.
   4. Should Coiled Wire Fabric Attachment Systems require wall mounting, the Contractor shall provide structure.
   5. Install manufacturer-supplied brackets and mounting hardware onto Coiled Wire Fabric Attachment Systems as indicated in shop drawings for specific Coiled Wire Fabric Attachment Systems. Attach with approved fasteners and techniques to ensure that sections are horizontal and parallel to grade/slab or rake to within 1/16 inch (1.58 mm) in 4 feet (1.2 m).
   6. Verify that support framing and other surfaces to receive Coiled Wire Fabric and Attachment Systems are clean and free of obstructions.

7. Follow shop drawings to attach Coiled Wire Fabric Attachment Systems to support framing using appropriate manufacturer supplied hardware.
8. Provide anchorage devices and fittings to secure to in-place construction; including additional frame work, blocking, threaded rods and anchors.
9. Install infill plumb, level, square, and rigid without kinks or sags.
10. Anchor Coiled Wire Fabric and Attachment Systems to mounting surfaces as indicated on the Drawings.
11. Separate dissimilar materials with bushings, grommets, or washers to prevent electrolytic corrosion.
12. Use manufacturer's supplied hardware.
13. Tension Coiled Wire Fabric per drawings, or as necessary, so that no slack is visible.
14. After final adjustment provide tamper resistant lock tight materials on all fittings.

3.04 ADJUSTING AND CLEANING

A. Remove temporary coverings and protection of adjacent work areas. Clean installed products before owner's acceptance.

B. Follow manufacturer's cleaning instructions. Provide to owner per Closeout Requirements.
   1. Vacuum dust and dirt from fabric with a brush-ended vacuum cleaner.
   2. Use mild detergent and damp rags to remove persistent dust or grease.
   3. Do not use abrasive cleaners.

C. Remove from project site and legally dispose of construction debris associated with this work.

3.05 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

C. Protect installed products and finished surfaces from damage during construction.

D. Replace defective or damaged components as directed by Architect.

END OF SECTION

SECTION 10 23 26
GLASS PARTITION SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Site-assembled demountable office partitions.- (**Not Used)**
   2. Glazing system for Saunas and Steam rooms.

1.02 RELATED SECTIONS

A. Section 01 33 00 - Submittal Procedures.

B. Section 01 40 00 - Quality Requirements.

C. Section 01 60 00 - Product Requirements.

D. Section 08 71 00 - Door Hardware.

E. Section 08 81 00 - Glazing.

1.03 REFERENCES

A. ANSI Z97.1 - Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test.

B. ASTM International (ASTM):
   1. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
   2. ASTM C1036 - Standard Specification for Flat Glass.
   3. ASTM C1048 - Standard Specification for Heat-Treated Flat Glass-Kind HS, Kind FT, Coated and Uncoated Glass.
   4. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

C. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum.

D. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Architectural Extrusions and Panels.

E. Builders Hardware Manufacturers Association (BHMA)

F. Glass Association of North America (GANA) - Glazing Manual.

G. ICC A117.1 - Standard for Accessible and Usable Buildings and Facilities.

H. NAAMM "Metal Finishes Manual for Architectural and Metal Products"

I. NFPA 70 - National Electrical Code (NEC).

J. UL 723 - Standard Test Method for Surface Burning Characteristics of Building Materials.

1.04 SUBMITTALS

A. Submit under provisions of Division 01 requirements.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
   2. Preparation instructions and recommendations.
   3. Storage and handling requirements and recommendations.
   4. Installation methods.

C. Shop Drawings: Include plans, elevations, sections, full-size details, and attachments to other work.
   1. Include details of provisions for assembly, showing the following:
      a. Joinery.
      b. Anchorage.

c. Glazing.
2. Include point-to-point wiring diagrams showing the following:
a. Power requirements for each electrically operated door hardware.

D. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from the installers of the items involved:
1. Glass partition systems.
2. Suspended-ceiling components and dimensioned ceiling-grid layout.
3. Locations of fixed door and window mullions.
4. Overhead bracing, and related structural members.
5. Ductwork above ceiling.
6. Ceiling mounted items, including the following:
a. Lighting fixtures.
b. HVAC ductwork, outlets, and inlets.
c. Speakers.
d. Sprinklers.
e. Smoke detectors.
f. Access panels.
7. Plenum acoustical barriers.

E. Verification Samples: For each finish product specified, two samples, minimum size 6 inches square representing actual product, color, and patterns.

F. Informational Submittals:
1. Qualification Data: For Installer.
2. Sample Warranties.

G. Procurement:
1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
2. Submit inventory to Owner within 5 days of delivery of materials.
3. See Sections 01 33 00 and 01 60 00.

H. Closeout Submittals:
1. Maintenance Data: For glass partition systems to include in maintenance manuals.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Minimum 5 year experience manufacturing similar products.

B. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

C. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.06 PRE-INSTALLATION MEETINGS

A. Convene minimum two weeks prior to starting work of this section.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store products in manufacturer's unopened packaging bearing the brand name and manufacturer's identification until ready for installation.

B. Handling: Handle materials to avoid damage.

1.08 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

1.09 SEQUENCING

A. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

PART 2 PRODUCTS

2.01 DEMOUNTABLE OFFICE PARTITIONS (NOT USED)

A. Acceptable Manufacturers and Products:
   1. Modernus: Riga Demountable Partition
      System 10 E 34th Street, FL 2
      New York, NY 10016
      800 755 8940
   2. Falkbuilt: Kai Glass Wall
      81 S 9th St, Suite 450
      Minneapolis, Minnesota 55402
      920 764 0773
   3. Substitutions: Not Permitted.
   4. Source Limitations: Obtain aluminum-framed partition system with sliding glass doors from single source from single manufacturer.

B. Site-Assembled Demountable Partitions:
   1. General: Site-assembled demountable-partition assembly and components that are the standard products of manufacturer.
   2. Performance Requirements:
      a. Surface-Burning Characteristics: Comply with ASTM E84 or UL 723 testing. Identify products with appropriate markings of applicable testing agency.
         1) Flame-Spread Index: 25 or less.
         2) Smoke-Developed Index: 450 or less.
      b. Structural Performance: Provide demountable partitions capable of withstanding the effects of gravity loads and stresses within limits and under conditions.
   3. Trim: Continuous, factory-finished.
      a. Adjustable for variations in floor and ceiling levels.
      b. Trim Material: Aluminum.
      c. Panel Joints: Closure trim.
      d. Outside Corner Trim: Square.
      e. Ceiling Trim Profile: Projected.
      f. Other pre-finished trim as indicated on drawings.
   4. Aluminum Finishes.
      a. Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
         1) Color Black.
   5. Glazing Frames: Manufacturer's standard aluminum frames for glazing thickness indicated.
      a. Material: Aluminum; Powder Coated
      b. Profile Heights: 1-3/8”
      c. Profile Width: 7/8”
      d. Frame Finish: As indicated on drawings.
      e. Carré Applique: Aluminum C-Channel; Powder Coated; Adhered to glass with 3M Double Adhesive Tape
   6. Glazing: Fully tempered clear float glass. Thickness: 3/8 inch.

7. Seals: Manufacturer's standard.
8. Hardware: By Manufacturer.
9. Doors: Sliding, Manufacturer's standard. See Door Schedule
10. Fabrication:
    a. General: Fabricate demountable walls for installation with concealed fastening devices and pressure-fit members that will not damage ceiling or floor coverings. Fabricate systems for installation with continuous seals at floor, ceiling, and other locations where partitions abut fixed construction.
    b. Panels for Site-Assembled Demountable Partitions: Face panels fabricated and finished in modular widths indicated.
        1) Transom Panels: Fabricated in material and finish to match wall panels unless otherwise indicated.
    c. Wiring: Conceal conductors and cables in raceways. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

2.02 GLAZING SYSTEM FOR SAUNA AND STEAM ROOMS

A. Acceptable Manufacturer:
    1. C.R. Laurence
        a. 2503 E Vernon Ave, Los Angeles, CA 90058-1826
        b. 800.421.6144. https://www.crlaurence.com/products/brands/listing/A07A_AH
    2. Substitutions: Not Permitted.
    3. Source Limitations: Obtain products from single source and from single manufacturer.

B. Aluminum Dry Glaze Partition System:
    1. General: Site-assembled demountable-partition assembly and components that are the standard products of manufacturer.
        a. Basis-of-Design Product: Subject to compliance with requirements, provide CRL DRS Low Profile Square Door and Sidelite Rails.
    2. Performance Requirements:
        a. Surface-Burning Characteristics: Comply with ASTM E84 or UL 723 testing. Identify products with appropriate markings of applicable testing agency.
            1) Flame-Spread Index: 25 or less.
            2) Smoke-Developed Index: 450 or less.
        b. Structural Performance: Provide demountable partitions capable of withstanding the effects of gravity loads and stresses within limits and under conditions.
    3. Rails: Continuous, factory-finished.
        a. Rail Material: Aluminum.
        b. Finish: Satin Anodized
        c. End Caps: As provided by Manufacturer.
        d. Products:
            1) Bottom Rail: #SR2SSA12SL
            2) Head and Jamb Rail: #WU1SA240
        e. Other pre-finished trim as indicated on drawings.
        f. Exposed-Metal Trim Finish: to match.
    4. Door Hardware:
        a. Sauna Door Pull:
            1) Manufacturer: ASSA ABLOY
            2) Product: Rockwood RM 4010 ArborMet
            3) Metal Finish: Satin Stainless Steel - US32D
            4) Grip Finish: Clear Coated Maple.
            5) Length: 36"
            6) Mounting: Back-to-Back Heavy Duty.
        b. Steam Door Pull:

1) Manufacturer: ASSA ABLOY
2) Product: Rockwood RM 2510 SoftMet
3) Metal Finish: Satin Stainless Steel - US32D
4) Grip Finish: Black Santoprene.
5) Length: 36"
6) Mounting: Back-to-Back Heavy Duty.

c. Hinge:
1) Manufacturer: C.R.Laurence
2) Product: Glass-to-glass oil dynamic hold open 180 degrees hinges.
3) Catalog Number: H8015BTSN
4) Finish: Brite Satin Nickel

d. Additional Required Hardware by Manufacturer.

5. Accessories:
a. Door Seal:
1) Manufacturer: C.R.Laurence
2) Product: 'h' Jamb Seal with Hard Leg for 180 Degrees
3) Catalog Number: P120HJ
4) Finish: Clear

C. Fabrication:
1. General: Fabricate for installation with concealed fastening devices and pressure-fit members that will not damage ceiling or floor substrates. Fabricate systems for installation with continuous seals at floor, ceiling, and other locations where partitions abut adjacent construction.

2.03 PERFORMANCE REQUIREMENTS

A. General Performance: Comply with performance requirements specified, as determined by testing of glass partition systems representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

B. Deflection of Framing Members:
1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding 1/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
2. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans of up to 13 feet 6 inches and to 1/240 of clear span plus 1/4 inch for spans greater than 13 feet 6 inches or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
3. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch.
a. Operable Units: Provide a minimum 1/16-inch clearance between framing members and operable units.

C. Regulatory Requirements: Provide tempered or laminated safety glass for locations subject to human impact as required by the applicable Building Code.

2.04 ACCESSORIES

A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, non-staining, non-bleeding fasteners and accessories compatible with adjacent materials.
1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
2. Reinforce members as required to receive fastener threads.
3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system, fabricated from 300 series stainless steel.

B. Anchors: Three-way adjustable anchors that accommodate fabrication and installation tolerances compatible with adjoining materials and recommended by manufacturer.

C. Decorative Glazing Film:

1. Manufacturer: Decorative Films.
2. Product: Solyx Bronze Frost SX-1305.
3. Material: Polymeric Vinyl film.
4. Adhesive: Pressure sensitive adhesive by manufacturer.
5. Roll width: 60"
6. Thickness: 4 mil.
7. Visible Light Transmission: 70%
8. Installation: see drawings for location. Install on exterior face (facing circulation) of glass partitions.

2.05 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Fabricate components that, when assembled, have the following characteristics:
   1. Profiles that are sharp, straight, and free of defects or deformations.
   2. Accurately fitted joints with ends coped or mitered.
   3. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

C. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 ERECTION TOLERANCES

A. Erection Tolerances: Install glass partition systems to comply with the following maximum tolerances:
   1. Level: 1/8 inch in 20 feet (3.2 mm in 6 m); 1/4 inch in 40 feet.
   2. Alignment:
      a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch wide, limit offset from true alignment to 1/16 inch.
      b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch (12.7 to 25.4 mm) wide, limit offset from true alignment to 1/8 inch.
      c. Where surfaces are separated by reveal or protruding element of 1 inch wide or more, limit offset from true alignment to 1/4 inch.
   3. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

3.03 INSTALLATION

A. General:
   1. Comply with manufacturer's written instructions.
   2. Do not install damaged components.
   3. Fit joints to produce hairline joints free of burrs and distortion.
   4. Rigidly secure non-movement joints.
   5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
   6. Seal perimeter and other joints watertight unless otherwise indicated.

B. Metal Protection:
   1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or installing nonconductive spacers.

C. Install components plumb and true in alignment with established lines and grades.

3.04 DEMOUNTABLE PARTITION INSTALLATION

A. Install partitions after other finishing operations have been completed.
   1. Install partitions rigid, level, plumb, and aligned. Install seals at connections with floors, ceilings, fixed walls, and abutting surfaces to prevent light and sound transmission.
   2. Except for filler panels scribed to fixed walls or columns, do not modify manufacturer's standard components.

B. Doors and Frames: Install door-and-frame and glazing-and-glazing-frame assemblies securely anchored to partitions and with doors aligned and fitted. Install and adjust door hardware for proper operation.

C. Electrical Devices: Connect integral, concealed wiring to serve electrical power and communication devices indicated on Drawings.
   1. Connect electrical service at junction-box locations according to Division 16 Section "Low-Voltage Electrical Power Conductors and Cables."
   2. Connect data communication service at junction-box locations according to Division 16 - Electrical requirements.

D. Erection Tolerances:
   1. Install each partition so surfaces vary not more than 1/8 inch from the plane formed by the faces of adjacent partitions.

3.05 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

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SECTION 10 28 13
TOILET AND BATH ACCESSORIES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Public-use washroom accessories.
   2. Public-use shower room accessories.
   3. Childcare accessories.
   4. Custodial accessories.

1.02 RELATED SECTIONS

A. Section 01 31 00 - Project Management and Coordination.

B. Section 01 33 00 - Submittal Procedures.

C. Section 01 40 00 - Quality Requirements.

D. Section 01 60 00 - Product Requirements.

E. Section 05 40 00 - Cold Formed Metal Framing.

F. Section 06 10 00 - Rough Carpentry.

G. Section 08 81 00 - Glazing.

H. Section 09 21 16 - Gypsum Board Assemblies.

I. Section 09 30 00 - Tiling.

J. Section 10 21 13.16 - Plastic Laminate Toilet Compartments.

1.03 REFERENCE STANDARDS

A. ASTM F446 - Standard Consumer Safety Specification for Grab Bars and Accessories Installed in the Bathing Area; 2019.

B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
   1. Identify locations using room designations indicated.
   2. Identify products using designations indicated.

C. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Construction Manager within 5 days of delivery of materials.
   3. See Sections 01 33 00 and 01 60 00.

1.05 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.06 WARRANTY

A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 PUBLIC-USE WASHROOM ACCESSORIES

A. Toilet Tissue (Roll) Dispenser:
   1. Provided by Owner, installed by Contractor.
      a. See section 01 64 00.

B. Paper Towel (Folded) Dispenser:
   1. Provided by Owner, installed by Contractor.
      a. See section 01 64 00.

C. Liquid-Soap Dispenser:
   1. Coordinate installation with Life Time's vendor.

D. Grab Bar:
   1. Products: Subject to compliance with requirements, provide products by one of the following:
      a. American Specialties, Inc., 3800 Series.
      b. Bobrick Washroom Equipment Inc., B-6806 Series.
      c. Bradley Corporation, 812 Series.
   2. Mounting: Flanges with concealed fasteners.
   3. Material: Stainless steel, 0.05 inch (1.3 mm) thick.
      a. Finish: Smooth, No. 4 finish (satin) on ends and slip-resistant texture in grip area.
   4. Outside Diameter: 1-1/2 inches (38 mm).
   5. Configuration and Length: As indicated on Drawings.

E. Sanitary-Napkin Disposal Unit:
   1. Products: Subject to compliance with requirements, provide products by one of the following:
      a. American Specialities Inc., No. 0852.
      b. Bobrick Washroom Equipment Inc., B-270.
      c. Bradley Corporation, Model 4781-11.
   2. Mounting: Surface mounted.
   3. Door or Cover: Self-closing, disposal-opening cover.
   4. Receptacle: Removable.
   5. Material and Finish: Stainless steel, No. 4 finish (satin).

F. Manufactured Mirror Unit: See drawings for size:
   1. American Specialties, 0600 Series.
   2. Or approved equal.

G. Frameless Mirror Glazing: By glazing provider. See 08 81 00.

H. SLIM dri Hand Dryer:
   1. World Dryer Model L-973 with Brushed Stainless Steel Finish.
   2. Or approved equal.

I. Self-Retracting Step: Stainless Steel.
   1. Step ‘n Wash model SNW-SS 975.
      a. Manufactured by Step ‘n’ Wash, Inc., 4829 Mill Brook Drive, Atlanta, Georgia 30338; (770) 677-4000 www.stepnwash.com.
      b. Construction: 14 gauge 304 stainless steel, reinforced with two (2) stainless steel plates Tig welded in place, one (1) stainless steel bracket and one (1) 304 stainless steel support rod.
      c. Mounting: Secured directly to concrete substrate utilizing four (4) stainless steel wedge anchors (supplied by manufacturer) with tension rating of 3999 lbs. and shear rating of 3031 lbs.
   2. Or approved equal.

2.02 PUBLIC-USE SHOWER ROOM ACCESSORIES

A. Shower Curtain Rod:

1. Products: Subject to compliance with requirements, provide products by one of the following:
    a. American Specialties, Inc., 1204-2 Shower Rod with 1204-1 Flange.
    b. Bobrick Washroom Equipment Inc., B-6047 Series.
    c. Bradley Corporation, Model 9531.
2. Description: 1-1/4-inch (32-mm) OD; fabricated from nominal 0.05-inch-(1.3-mm) thick stainless steel.
3. Mounting Flanges: Stainless-steel flanges designed for exposed fasteners.
4. Finish: No. 4 (satin).

B. Shower Curtain: By Owner.

C. L Shaped Folding Shower Seat:
1. Products: Subject to compliance with requirements, provide products by one of the following:
    a. American Specialties Inc., 8206 (L/R).
    b. Bradley Corporation, 9569.
2. Configuration: L-Shaped.
3. Seat: Phenolic or polymeric composite of slat-type or one-piece construction in color as selected by Architect.
4. Mounting Mechanism: Stainless steel, No. 4 finish (satin).
5. Dimensions: 21” x 32” – see drawings.

D. Rectangular Folding Shower Seat:
1. Products: Subject to compliance with requirements, provide products by one of the following:
    a. American Specialties Inc., 8203-20.
    b. Bradley Corporation, 9562.
2. Configuration: Rectangular.
3. Seat: Phenolic or polymeric composite of slat-type or one-piece construction in color as selected by Architect.
4. Mounting Mechanism: Stainless steel, No. 4 finish (satin).
5. Dimensions: 28 1/2” x 15” – see drawings.

E. Towel Hook:
1. Products: Subject to compliance with requirements, provide products by one of the following:
    a. American Specialties Inc., 7340-S.
    b. Bobrick Washroom Equipment Inc., B-6717.
    c. Bradley Corporation, 9114.
2. Description: Single-prong unit.
3. Material and Finish: Stainless steel, No. 4 finish (satin).

F. Swimsuit Water Extractor:
1. Products: Subject to compliance with requirements, provide:
    a. The Swimsuit Dryer: Next Generation wall mounted dryer.
    b. Or approved equal.
    c. Color: Cool Gray.
    d. Coordinate with Plumbing and Electrical.

G. Shampoo and Lotion Brackets Showers:
1. Provided by Owner, installed by Contractor.
    a. See section 01 64 00.

H. Weight Scales:
1. Products: Subject to compliance with requirements, provide products by one of the following:
    a. Benchmark SS Steel Bench Scale.
2. Configuration: Rectangular.
3. Material: 304 Stainless Steel.
4. High traction adjustable feet
5. Dimensions: 18" x 18"

I. Weight Scale Display:
   1. Products: Subject to compliance with requirements, provide products by one of the following:
      a. Rice Lake Weighing Systems: 680 Synergy Plus Digital Weight Indicator.
   2. Industrial grade.
   3. Material: 304 stainless steel.
   4. Seven Digit display.
   5. See drawings for mounting heights and details.

2.03 CHILDCARE ACCESSORIES

A. Diaper-Changing Station:
   1. Provided by Owner, installed by Contractor.
      a. See section 01 64 00.

B. Self Retracting Step Stools:
   1. Products: Step ‘n Wash LLC, model SNW-SS 975B. Floor-mounted with concealed gas cylinder for self-retracting up and down movement. www.stepnwash.com.
      a. Side supports (legs) constructed from 14-gauge, type 304 stainless steel . Steps shall be constructed from 16-gauge type 304 stainless steel and reinforced with 16-gauge stainless steel welded brackets.
      b. Marine-grade non-slip rubber tread and ANSI-compliant graphics with text in English, Spanish, and French.
      c. Load capacity of 800 lbs.

2.04 CUSTODIAL ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products from one of the following:
   1. American Specialties, Inc.
   2. Bobrick Washroom Equipment, Inc.
   3. Bradley Corporation.
   4. Or approved equal.

B. Paper Towel (Folded) Dispenser:
   1. Provided by Life Time vendor.

C. Foam Soap Dispenser: All locations except shower.
   1. Provided by Life Time vendor.

2.05 MOUNTING ACCESSORIES

A. Stainless Steel Screws:
   1. #10 1 3/4" length 18-8 Stainless Steel Screw.

B. Nylon Spacer
   1. 7/16" length plain round nylon spacer for #10 screw.

2.06 FABRICATION

A. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of 6 keys to Owner's representative.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install accessories per manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Install all accessories on surfaces which are waterproofed (tile walls in wet areas, see drawings) according to the waterproofing manufacturer's instructions. See Section 09 30 00 - Tiling.

C. Grab Bars: Install to withstand a downward load of at least 250 lbf (1112 N), when tested according to ASTM F446.

END OF SECTION

SECTION 10 28 19
GLASS SHOWER DOORS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Tempered Glass Shower Doors.
   2. Hardware.
   3. U-Channel.

1.02 RELATED SECTIONS

A. Section 01 33 00 - Submittal Procedures.

B. Section 01 40 00 - Quality Requirements.

C. Section 01 60 00 - Product Requirements.

D. Section 01 92 00 - Facility Operation and Maintenance.

E. Section 08 81 00 - Glazing.

F. Section 09 30 00 - Tiling.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For shower compartments. Include plans, elevations, sections, details, and attachments to other work.

C. Samples for Verification: For the following products, unless otherwise indicated:
   1. Glass sample, prepared on 6-inch- (152-mm-) square of same thickness and material indicated for Work.
   2. Each type of hardware and accessory.

D. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.
   3. See Sections 01 33 00 and 01 60 00.

E. Operation and Maintenance Data: Submit O&M manuals according to the requirements of Section 01 92 00 - Facility Operation and Maintenance.

1.04 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities" and ICC/ANSI A117.1 for glass shower doors designated as accessible.

1.05 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of shower partitions, and other construction contiguous with glass shower doors by field measurements before fabrication.

PART 2 PRODUCTS

2.01 GLAZING

A. See Glass type G8, Section 08 81 00.

2.02 ACCESSORIES

A. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories.
   1. Material: Stainless steel.
   2. Hinges: Manufacturer's standard continuous, cam type that swings to a closed or partially open position.
      a. Manufacturer: C. R. Laurence Co., Vienna, Wall Mount Hinge, Cat. No. V1E037 (3 hinges per door). Finish: Satin Nickel.
   3. Door Pull: C. R. Laurence Co., Door Pull, Cat. No. BM8X8. Finish: Satin Nickel.
   4. Misc Brackets, fasteners:
      a. C.R. Laurence Co., Vienna Series. Finish to match Hinge. See drawings for number and location.

B. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match the items they are securing, with theft-resistant-type heads.

PART 3 EXECUTION

3.01 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.

3.02 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on swinging doors to return doors to fully closed position.

END OF SECTION

SECTION 10 44 00
FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Fire protection cabinets for fire extinguishers.
   2. Portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

1.02 RELATED REQUIREMENTS

A. Section 01 33 00 - Submittal Procedures.

B. Section 01 40 00 - Quality Requirements.

C. Section 01 60 00 - Product Requirements.

D. Section 01 92 00 - Facility Operation and Maintenance.

E. Section 09 21 16 - Gypsum Board Assemblies.

F. Section 09 30 00 - Tiling.

G. Section 09 74 16 - Wood Veneer Wall Covering.

H. Section 09 75 00 - Interior Stone.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For fire protection cabinets. Include plans, elevations, sections, details, and attachments to other work.

C. Operation and Maintenance Data: Submit O&M manuals according to the requirements of Section 01 92 00 - Facility Operation and Maintenance.

1.04 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

C. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

D. Coordinate type and capacity of fire extinguishers with fire protection cabinets to ensure fit and function.

E. Coordinate sizes and locations of fire protection cabinets with wall depths.

PART 2 PRODUCTS

2.01 FIRE PROTECTION CABINET

A. Standard Cabinet: Suitable for fire extinguishers, general areas.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. JL Industries, Inc., a division of Activar Construction Products Group: Academy Series with V Door and Safe-T-Lok opt.
      b. Larsen's Manufacturing Company: Architectural Series-AL with vertical duo door style and Larsen-Lok opt.
      c. Modern Metal Products, Division of Technico Inc: FSB Series.
      d. Approved substitution.
   2. Cabinet Material: Aluminum sheet.
   3. Cabinet Mounting:
      a. (FEC-1) Semi-recessed Cabinet: As indicated on drawings. Cabinet box partially recessed in walls of sufficient depth to suit style of trim indicated; with one-piece combination trim and

perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend). Provide where walls are of insufficient depth for recessed cabinets but are of sufficient depth to accommodate semi-recessed cabinet installation.
1) Square-Edge Trim: 1-1/4- to 1-1/2-inch backbend depth.

b. (FEC-2) Surface mounted: As indicated on drawings.
c. (FEC-3) Fully Recessed: As indicated on drawings. Metal trim as provided by manufacturer.

4. Cabinet Trim Material: Aluminum sheet.
5. Door Material: Aluminum sheet.
6. Door Style: Vertical duo panel with frame.
7. Door Glazing: Clear tempered glass.
8. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
9. Finishes: Aluminum Clear Anodic.

B. (FEC-4) Moisture and Chemical Resistant Fire Extinguisher Cabinet: Suitable for fire extinguishers, to be used in pool areas.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Cato, Inc. Chief CHPCP-5.
b. JL Industries, Inc., a division of Activar Construction Products Group: ABS Plastic Indoor/Outdoor Cabinet.
c. Or approved equal.
2. Cabinet Material ABS Plastic.
3. Cabinet Mounting: Surface Mounted.
4. Door: Clear acrylic.
5. Door Hardware: Manfuacturer's standard corrosion resistant hardware of proper type for cabinet and door.
6. Color: White.

C. Accessories:
1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
2. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle.
3. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as directed by Architect.
a. Identify fire extinguisher in fire protection cabinet with the words "FIRE EXTINGUISHER".
1) Location: Applied to location indicated on Drawings.
2) Application Process: Decals.
3) Lettering Color: Red.
4) Orientation: Horizontal or as indicated on Drawings.

2.02 FABRICATION

A. Fire Protection Cabinets: Provide manufacturer's standard box (tub), with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated. Miter and weld joints and grind smooth.

2.03 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. General use ABC Fire Extinguishers: Multipurpose Dry-Chemical Type in Steel Container: UL-rated 3-A:40-B:C, 5 pound (2.5-kg) nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container. Type, size, and capacity for each fire protection cabinet and mounting bracket indicated.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. JL. Industries, Inc.; a division of Activar Construction Products Group: Cosmic 5e

b. Kidde Residential and Commercial Division; Subsidiary of Kidde plc.: Pro 5MP
c. Kidde Residential and Commercial Division; Subsidiary of Kidde plc.: Excel XL10TC2.
d. Larsen's Manufacturing Company: MP5
e. Approved substitution.

2. Valves: Manufacturer's standard.
3. Handles and Levers: Manufacturer's standard stainless steel.
4. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B and bar coding for documenting fire extinguisher location, inspections, maintenance, and recharging.

B. Type "K" fire extinguishers for food service areas:
1. Manufacturers: UL rated for Class A and K fires. Subject to compliance with requirements, provide products by one of the following:
a. JL. Industries, Inc. a division of Activar Construction Products Group; Saturn 15
b. Kidde Residential and Commercial Division; Subsidiary of Kidde plc.: Six Liter Class K 25074
c. Larsen's Manufacturing Company: WC 2 1/2
2. Valves: Manufacturer's standard.
3. Handles and Levers: Manufacturer's standard stainless steel.
4. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B and bar coding for documenting fire extinguisher location, inspections, maintenance, and recharging.

2.04 MOUNTING BRACKETS

A. Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Amerex Corporation. Trussville Alabama.
b. Ansul Incorporated; Tyco International Ltd. Sentry Brand.
c. Badger Fire Protection; a Kidde company.
d. Buckeye Fire Equipment Company. North Carolina.
e. L. Industries, Inc.; a division of Activar Construction Products Group.
f. Larsen's Manufacturing Company.
g. Potter Roemer LLC. Chicago area.
h. Approved substitution.

B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.
1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
a. Orientation: Horizontal.

PART 3 EXECUTION

3.01 INSTALLATION

A. Examine walls and partitions for suitable framing depth and blocking where semi-recessed cabinets will be installed and prepare recesses as required by type and size of cabinet and trim style.

B. Install fire protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.

C. Fire Protection Cabinets: Fasten cabinets to structure, square and plumb.

D. Identification: Apply decals at locations indicated.

E. Adjust fire protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

F. Replace fire protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

G. Examine fire extinguishers for proper charging and tagging.
   1. Remove and replace damaged, defective, or undercharged fire extinguishers.

H. Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
   1. Mounting Brackets: 40 inches above finished floor to top of fire extinguisher.

I. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION

SECTION 11 08 00
COMMISSIONING OF EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

A. This section includes specific requirements that apply to the implementation of the Commissioning Process and this Division Contractors' participation in this process. This section details the project specific equipment and systems that are included in the Commissioning Process. For general descriptions and responsibilities, refer to SECTION 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

1.02 RELATED DOCUMENTS

A. The Owner's Project Requirements (OPR) document.

B. The Basis of Design (BoD) document.

C. The Project Commissioning Plan (CxP) document.

D. ASHRAE Standard 202-2013 - Commissioning Process for Buildings and Systems.

E. LEED v4 for Building Design and Construction.

1.03 RELATED SECTIONS

A. SECTION 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS

B. SECTION 07 08 00 - COMMISSIONING OF THERMAL AND MOISTURE PROTECTION

C. SECTION 08 08 00 - COMMISSIONING OF OPENINGS

D. SECTION 13 08 00 - COMMISSIONING OF SPECIAL CONSTRUCTION

E. SECTION 14 08 00 - COMMISSIONING OF CONVEYING SYSTEMS

F. SECTION 21 08 00 - COMMISSIONING OF FIRE SUPPRESSION SYSTEMS

G. SECTION 22 08 00 - COMMISSIONING OF PLUMBING SYSTEMS

H. SECTION 23 08 00 - COMMISSIONING OF MECHANICAL SYSTEMS

I. SECTION 25 08 00 - COMMISSIONING OF INTEGRATED AUTOMATION SYSTEMS

J. SECTION 26 08 00 - COMMISSIONING OF ELECTRICAL SYSTEMS

K. SECTION 27 08 00 - COMMISSIONING OF COMMUNICATIONS SYSTEMS

L. SECTION 28 08 00 - COMMISSIONING OF SAFETY AND SECURITY SYSTEMS

M. SECTION 33 08 00 - COMMISSIONING OF UTILITIES

1.04 DEFINITIONS

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

1.05 RESPONSIBILITIES

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

PART 2 PRODUCTS

2.01 NO PRODUCTS SUPPLIED

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

B. Contractors and/or Vendors shall provide the specialty testing equipment necessary to fulfill the functional testing requirements, for the duration of the testing period.

PART 3 EXECUTION

3.01 GENERAL

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.02 MEETINGS

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.03 SYSTEM START-UP

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.04 PRE-FUNCTIONAL CHECKLISTS

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.05 FUNCTIONAL PERFORMANCE TESTING

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.06 TRAINING

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.07 SYSTEMS TO BE COMMISSIONED

A. GENERAL
   1. Commissioning specifications supplement the requirements of individual specifications sections but shall not be interpreted to replace or diminish the specified scope of any individual section.
   2. For all systems listed below, Division Contractor shall comply with all commissioning requirements specified.

B. APPLICABLE SYSTEMS
   1. Commercial Laundry Equipment – Checklist only

END OF SECTION

SECTION 11 21 73
COMMERCIAL LAUNDRY EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Commercial washers.
   2. Commercial dryers.
   3. Steel base.
   4. Lint filters.
   5. Drain Trough.
   6. Edge Gasket.

B. Contractor-Furnished Equipment: Washers, dryers and lint filters to be delivered to Project. Installer to provide proper connections and venting.

1.02 RELATED SECTIONS

A. Section 01 33 00 - Submittal Procedures.

B. Section 01 40 00 - Quality Requirements.

C. Section 01 60 00 - Product Requirements.

D. Section 01 92 00 - Facility Operations and Maintenance.

E. Section 11 08 00 - Commissioning of Equipment.

F. Section 22 40 00 - Plumbing Fixtures.

G. Section 26 27 17 - Equipment Wiring.

1.03 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00.

1.04 SUBMITTALS

A. Product Data including manufacturer's specification for installation. Provide data substantiating that products comply with requirements.

B. Shop Drawings: show equipment layout, drainage trough, base, curb details, and coordination with plumbing.

C. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.
   3. See Sections 01 33 00 and 01 60 00.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with requirements, provide and install the following:
   1. Electrolux:
      a. Or approved equal.
      b. Contact: David Selib; Laundrylux. 516-371-4400 dselib@laundrylux.com

2.02 EQUIPMENT

A. Dryers:
   1. Style: Commercial Tumble Dryer.
      a. Acceptable Product: Electrolux DE683

B. Washers:
   1. Style: Washer Extractor.
      a. Acceptable Product: Electrolux EUD-660 CV

b. One washer base per machine.
1) Steel base by Manufacturer.
2) Coordinate height with drain trough and curb.

C. Steel equipment base:
1. By Manufacturer, coordinate height with Drain Trough and curb.

D. Lint Filters:
1. Acceptable Product: Small Wonder OPL-202 with wall mount by Clean Cycle Systems.
a. Or approved equal.

E. Drain Trough:
1. Acceptable Product: Polypropylene Trough.
a. Height: Coordinate with washers, base, curb, plumbing and installation details to ensure proper drainage.
b. Sizing: See drawings for proposed sizing.
c. Drainage:
1) Trough to be configured for top gravity drain.
2) Coordinate location of drain apperatures with equipment layout.

2.03 ACCESSORIES

A. Edge gasket: Natural Elastic Abrasion Resistant Rubber. (gum rubber)
1. Temperature range: -45 to 200 deg F.
2. Tensile Strength >/= 2500 psi.
3. Thickness: 1/16" Min.
4. Width: See detail.
5. Color: White, Gray or Tan.

PART 3 EXECUTION

3.01 EXAMINATION

A. Field verify location and sizes of curbs, plumbing and electrical connections.

B. Ensure waterproofing has been installed and is in acceptable condition prior to installation.

3.02 COORDINATION

A. Coordinate locations of washer drains with curb, base, drain trough and floor drains to ensure proper functioning of equipment.

B. Ensure that electrical connections are well clear of plumbing connections and wet areas.

3.03 INSTALLATION

A. Install equipment according to Manufacturer's Instructions, details and approved shop drawings.

3.04 PROTECTION

A. Protect installed equipment from other construction activities.

3.05 TESTING

A. Test all equipment for proper functioning and according to Commissioning requirements, see 11 08 00.

3.06 OPERATIONS AND MAINTENANCE

A. Provide training and O&M materials as specified in Section 01 92 00.

END OF SECTION

SECTION 114000
FOODSERVICE EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes some or all:

1. Fabricated equipment.
2. Food waste machines.
3. Cooking equipment.
4. Refrigeration equipment.
5. Walk-in refrigeration equipment.
6. Powered food-preparation equipment.
7. Warewashing equipment.
8. Serving equipment.

B. Owner-Furnished Equipment: Where indicated, Owner will furnish and install owner supplied equipment.

C. Related Sections:

1. Division 21, 22, and 23 Sections for supply and exhaust fans; exhaust ductwork; service roughing- ins; drain traps; atmospheric vents; valves, pipes, and fittings; fire-extinguishing systems; and other materials required to complete foodservice equipment installation.
2. Division 26 Sections for connections to fire-alarm systems, wiring, disconnect switches, and other electrical materials required to complete foodservice equipment installation.

1.3 PROJECT DESCRIPTION

A. Scope of Work: work called out in FSEC plans and contract will be performed within the contract price. It is clearly understood and agreed that the FSEC shall provide all material, labor, trucking, hoisting, shop drawings, layout, equipment, supervision, insurance, applicable taxes, bonds, etc., necessary for the furnishing and installation of all specified work contained herein in accordance with the contract drawings, specifications, addenda and riders, all of which become part of this Contract. The scope of work shall include, but be limited to, all the Food Service Equipment work shown on the drawings and described in the following Specifications Section, except such work as may be specifically excluded.

B. Intent of Documents: The intent of the contract documents is to describe complete systems and items. Provide appurtenances and accessories specified in the specifications or indicated on the drawings required for a complete installation and safe functioning of equipment or systems.

C. The contract documents are complimentary, and what is required by one shall be as binding as if required by all. In the event that there are discrepancies in or between the documents, neither shall be interpreted as taking precedence over the other. Notify the Architect or Kitchen Designer of all discrepancies in writing. The Kitchen Designer or Architect will issue a written clarification.

D. Terms and Abbreviations: The following abbreviations are used on the drawings.

1. EC: Electrical Contractor
2. GC: General Contractor or other Prime Contractors
3. HVAC: Heating, Ventilation, Air Conditioning Contractor
4. ID: Interior Designer
5. KEC: Kitchen Equipment Contractor
6. MWC: Millwork Contractor
7. ONR: Owner
8. OPR: Operations and Engineering
9. PC: Plumbing Contractor
10. VDR: Vendor

E. Work by Owner and Under Other Contracts: During the course of the work, separate contracts may be let for other work. Coordinate work under the contract required for smooth completion of the work.

F. General construction coordination requirements under separate contract and not included in Kitchen Equipment Contractor (KEC) scope of work:

1. Coordination of furnishing of specialized fittings to installing trade for installation into work.
2. Furnishings including, tables, chairs, cash registers, point of sale systems, cashier stools, furniture are provided under separate contracts. Coordinate installation with kitchen equipment.
3. Miscellaneous equipment and systems including rolling stock, dispensing systems for juice, and soda, beverage conduit, cooking utensils, dishes, flatware, soap and chemical injection systems, except as specified.
4. Beverage line conduit or cable trays, including boring necessary holes.
5. Grout backfill around floor pans and sealing around floor pans and equipment.

G. HVAC coordination requirements under separate contract and not included in KEC scope of work:

1. Final duct connection, connecting duct work, controls and blowers to ventilation hoods.
2. Receiving, Hanging & leveling of all hoods, wall panels and controls.
3. Air balance testing.
4. HVAC services required for operation of equipment.

H. Plumbing coordination requirements under separate contract and not included in KEC scope of work:

1. Final connections and interconnections including traps, floor troughs, trench drains, drain lines, connection pipe, shut off valves, connection to equipment items.
2. Verify incoming hot water.
3. Interconnecting piping from booster to dishwasher.
4. Plumbing services required for operation of equipment. Including water Temperature, Pressure and hardness

I. Electrical coordination requirements under separate contract and not included in KEC scope of work:

1. Final connections and interconnections of equipment including external wiring, connecting conduit, and external connections to equipment.
2. Required electrical equipment shut off devices.
3. Installation of electrical control switches and starters not part of or attached to equipment.

4. Electrical services required for operation of equipment.

J. Use of Site: Limit use of site to extent required to perform work and to limits indicated on drawings.

1. Keep entrances clear and available.
2. Do no block entrances, fire exits or lanes, or delivery routes.
3. Do no use unauthorized areas for parking or storage of materials.
4. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on site.
5. Immediately remove any crating or other debris resulting from installation of Food Service Equipment and dispose of in general contractor supplied dumpster

K. Noise Control: Minimize objectionable noise levels and notify Owner in advance of noisy operations.

1. The Owner reserves the right when necessary to require excessive noise transmitting procedures be stopped during certain periods of time.

L. Owner Occupancy

1. Full Owner Occupancy: The Owner will occupy site and existing building during entire construction period. Occupancy and placing of equipment during the work does not constitute acceptance of the work.

1.4 GENERAL CONDITIONS

A. The KEC represents that it is familiar with, and has expertise in the work of this Scope. The KEC further agrees that it will provide all work for the Scope as may be required to make a complete job of that which may not be fully defined in the Contract Documents.

B. The KEC has examined the site and the contract documents and reviewed with the Construction Manager the designated areas of access, delivery, and storage for the Contractor's use. The KEC agrees that such areas are satisfactory and sufficient for its needs in the prosecution of its work in the conformance with the terms of the contract. Any changes in such areas shall not be permitted without the approval of the FSEC, Construction Manager and Owner, which if approved, shall be at no additional cost.

C. All hoisting and hoisting requirements less than 35' for the KEC's materials and equipment are the KEC's responsibility. The KEC shall place its hoisting equipment in locations approved by the Construction Manager. Any separate hoist engines shall be relocated as required as the project progresses if required by the Construction Manager so as to avoid interference with work of other contractors.

D. Any temporary openings or leaveouts required for subsequent installation of KEC's work must be brought to the attention of the Construction Manager prior to the start of the pertinent work in the areas of the opening or leaveout needed. Failure to request access will result in the KEC assuming all costs involved in providing, rebuilding, and refinishing the required access.

E. The KEC will provide protection necessary to safeguard its own work, as well as the work of other trades, from damage by its own operations.

F. The KEC will visit and carefully examine the premises upon which the building is being erected and familiarize itself with the existing conditions and difficulties that may affect the execution of its work. The KEC is aware that its work is being performed adjacent to other ongoing work. The KEC agrees that it will take all necessary steps to avoid damage to new and existing construction. Any damage caused by the KEC will be repaired by the KEC at no additional cost.

G. All permits required for the KEC's work shall be procured and paid for the by KEC.

H. This KEC shall cooperate, as directed by the Construction Manager, with other contractors that shall be commencing operations on the site prior to this KEC's completion and demobilization.

I. The Construction Manager must approve all on-site material storage locations.

J. Should the KEC propose any design changes that might save in costs, he will submit his proposal, drawings, calculations, etc., for approval by the Kitchen Consultant. The KEC will assume all costs for reimbursing the Owner for all fees incurred by the Engineer of Record as a result of said changes.

1.5 PROJECT COORDINATION AND MEETINGS

A. Coordination of Work by the Kitchen Equipment Contractor: Coordinate scheduling of kitchen equipment, submittals, and specified kitchen equipment work to ensure efficient and orderly sequence of installation of interdependence.

1. Review kitchen designer's drawings for completeness and accuracy with equipment being furnished. Notify Owner or his agent in writing of changes required with copy to the kitchen designer.
2. Examine utility rough-ins in field prior to closing of walls and ceilings. Notify the Owner or his agent in writing of discrepancies.
3. Protect wall ends and columns during the installation of kitchen equipment work.

B. Prior to commencement of work, KEC to verify with GC that the installation conditions are acceptable and ready to receive kitchen equipment, including but not limited to:

1. Field measurement and verification of finished dimensions for placement of equipment and manufactured items. Coordinate requirements with affected trades for alternations necessary to accommodate equipment and manufactured items.
2. Verify physical space conditions are acceptable for installation of specified equipment.
3. Note obstructions; scribe and fit equipment to and around obstructions ensuring a sanitary, homogeneous installation.
4. Verify floor pans and walk-in depressions are correctly located and sized.
5. Verification that mechanical and electrical work complies with the drawings as closely as possible, including routing shown for pipes, ducts, and conduit.
6. Verification that openings receiving equipment including drilling of holes, installation of mechanical, plumbing, electrical, and refrigeration connections are ready to receive kitchen equipment work.
7. Verification that required concrete and masonry work required are ready for installation of kitchen equipment.
8. Verification of installation of beverage conduit and cable trays and coordination with owners beverage installer for a complete and sanitary install.

C. Meetings: Kitchen Equipment Contractor shall participate, virtual or in person, in meetings as required for coordination of kitchen equipment specified under this contract.

1.6 PROJECT PROCEDURES

A. Cutting and Patching: When the installation of kitchen equipment requires minor cutting and patching of existing work.

1. Submit written request in advance of cutting or altering structural or building enclosure elements.
2. Fit work tight to adjacent elements. Maintain integrity of wall, ceiling, or floor construction; completely seal voids.
3. Refinish surfaces to match adjacent finishes.
4. Restore to original or required fire and smoke ratings.

B. Protection of Work: Protect existing and new work and equipment from damage until the work is complete and materials and apparatus have been tested and accepted. Repair or replace at no expense to Owner, Architect, or Consultants.

C. Existing Conditions: Exercise care to prevent damage to existing work, equipment, fixtures, utilities, and similar items during construction period until final acceptance.

D. New Construction and Equipment: Protect work, equipment and materials in accordance with recommendations of manufacturer. Cover work, equipment, and materials to protect from dirt, construction dust, traffic, wear, and injury including damage from workmen; promptly repair damage to work of other trades, existing conduits, ducts, drains, sewers, pipes, utilities, and similar items resulting from installation procedures and methods at no expense to the Owner.

1.7 DEVIATION FROM THE CONTRACT DOCUMENTS

A. Design Criteria: Dimensions specified by kitchen designer for equipment, systems, and manufactured items, including mechanical and electrical connections are intended to establish general profiles and physical characteristics. Final drawings, dimensions and utility information are the responsibility of the KEC. Verify in accordance with specifications.

1.8 ACTION SUBMITTALS

A. Product Data: Manufacturer's technical specifications for each type of equipment.. Also include the following:

1. Manufacturer's model number.
2. Accessories and components that will be included for Project.
3. Utility service connections for water, drainage, power, and fuel; include roughing-in dimensions.

B. Shop Drawings: For fabricated equipment. Include plans, elevations, sections, roughing-in dimensions, fabrication details, utility service requirements, and attachments to other work.

1. KEC to submit digital , at minimum ¼" scale with horizontal and vertical control for:

    a. All utility services and points of connection to equipment.
    b. Slab depressions.
    c. Wall and partition locations
    d. Ventilation duct locations and air volumns
2. Submit within 4 weeks digital shop drawings at minimum 1/2" scale for fabricated equipment showing construction details, reinforcement, installation and relationship to adjoining and related work, attachment and anchorage if necessary
3. Submit within 4 weeks after award of contract a digital copy of specifications with specified model number, options, accessories, modifications and Utility requirements.
4. The above documents are not to be issued to the field until all drawings and manufacturer's data have been stamped approved by Architect and Kitchen Designer.
5. Purchasing and fabrication of equipment is not to be started until related submittals have been approved.
6. Upon receipt of approval of submittals provided to Architect for distribution.

C. Samples: Submit the following items as necessary:

1. Items requested by Owner and Architect, of adequate size and quantity for testing and review.
2. Include any costs of samples in contract sum.

D. Wiring Diagrams: Submit schedule showing proposed electrical characteristics of each piece of equipment and disconnect means provided.

1.9 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For foodservice equipment to include in operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. If requested, Provide maintenance data for each item of food service equipment for all equipment with a plumbing or electrical connection . At project closeout submit digital copies.
2. Submit as built shop drawings of each piece of custom equipment.
3. Provide name, telephone number of service company or manufacturers service contact for each piece of equipment for equipment requiring plumbing or electrical connnection, so service or spare parts can be readily obtained.
4. Kitchen Designer will maintain one identical file copy.

B. Test each heated, cooled, or mechanical operated fixture in accordance with industry standards and manufacturer's recommendations.

1.10 QUALITY ASSURANCE

A. Regulatory Requirements:

1. NSF Standards: Comply with applicable National Sanitation Foundations standards, or approved alternate, and recommended criteria. Provide each principal item of food service equipment with NSF *Seal of Approval*.
2. UL Labels: Provide UL Labels on prime electrical components of food service equipment, as applicable. Provide UL recognized marking on items with electrical components, signifying listing by UL, as applicable.
3. ANSI Standards: Comply with applicable ANSI standards for electric powered and gas burning appliances, for piping to compressed gas cylinders, and for plumbing fittings including vacuum breakers and air gaps to prevent siphonage in water piping.
4. NFPA Codes: Install food service equipment in accordance with National Fire Protection Codes (NFPA):

    a. NFPA 54 National Fuel Gas Code.
    b. NFPA 70 National Electrical Code.
    c. NFPA 96 Removal of Smoke and Grease Laden Vapors from Commercial Cooking Equipment.

5. ASME Boiler Code: Construct steam generating and closed steam heating equipment to comply with American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code; Section IV for units not exceeding 15 psi or 250 degrees F (121 degrees C), or Section I for higher pressure/temperature units.
6. Health Code Requirements: Comply with all requirements of the Health Department that has jurisdiction at the project.

B. Certification Labels: Provide equipment complying with standards and bearing appropriate certification labels:

1. AGA certification for all Gas connected equipment.
2. UL Standards: Electrical components with UL labels.
3. NSF Standards: Equipment and fabricated items with NSF labels.

C. All equipment shall be provided and installed in accordance with laws, ordinances, rules, codes and regulations of all authorities having jurisdiction.

D. Manufacturers' Qualifications: Firm regularly engaged in manufacturer of food service equipment and having minimum 5 years documented experience with types, capacities, and sizes required.

E. Installer's Qualifications: Experienced Installer having minimum 5 years documented experience with installation of food service similar in material, design, and extent.

F. Preinstallation Conference: Conduct conference with Project site staff.

1.11 QUALITY CONTROL

A. Control of Installation: Monitor quality control over manufacturers, fabricators, site conditions, and workmanship to protect work of specified quality

1. Comply with manufacturer's instructions.
2. Comply with specified standards for minimum quality requirements except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

B. References: Comply with references standards by date of issue current as of date of contract documents. In the event of conflict, request clarification prior to commencement of work.

1.12 MATERIALS AND EQUIPMENT

A. Products: Provide new materials, components, equipment, fixtures, and systems to form work. Use interchangeable components of the same manufacturer for similar components.

B. Transportation, Handling, Storage, and Protection: Transport, handle, store, and protect materials in accordance with manufacturer's instructions.

C. Product Options:

1. Referenced Standards: Any product or materials meeting standards or description.
2. Performance Characteristics: Products or materials stating minimum primary performance requirements, characteristics, or features necessary for the proper function and application of the item.
3. Proprietary items: Products or materials of named manufacturer and meeting specifications; no options or substitutions allowed.
4. Semi-proprietary Items: Products or materials of named manufacturers and meeting specifications; contractor's option of manufacturer.

1.13 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in manufacturer's protective containers. Inspect containers and equipment promptly upon receipt for damage. Do not accept delivery of damaged items.

B. Verify all specified equipment is delivered and labeled for intended location using equipment numbering system indicated on drawings and in the specifications.

C. Store kitchen equipment in original containers under cover and provide protection to equipment.

D. Handle kitchen equipment carefully to avoid damage to components, enclosures, and finish. Do not install damaged equipment; replace and return damaged components to equipment manufacturer.

1.14 PROJECT CONDITIONS

A. Obtain final Architectural, Mechanical, Plumbing, Electrical, Structural and Interior Design Drawings prior to preparing submittals or beginning work.

B. Provide materials, equipment, components, and accessories new and of kinds specified and in undamaged condition when turned over to Owner. Provide workmanship of best quality by skilled craftsmen.

1. Provide appliances of rigid construction, free from objectionable vibrations, and quiet in operation.

C. Take field measurements to assure accurate fit of Fabricated equipment

D. Before beginning work review documents for conflicts with Food Service Equipment. Notify the Architect of any conflicts.

1.15 COORDINATION

A. Coordinate foodservice equipment layout and installation with other work, including layout and installation of lighting fixtures, HVAC equipment, and fire-suppression system components.

B. Coordinate locations and requirements of utility service connections.

C. Coordinate sizes, locations, and requirements of the following:

1. Overhead equipment supports.
2. Equipment bases.
3. Floor depressions.
4. Insulated floors.
5. Floor areas with positive slopes to drains.
6. Floor sinks and drains serving foodservice equipment.
7. Roof curbs, equipment supports, and penetrations.

1.16 WARRANTY

A. KEC shall be fully responsible for all warranties and/or guarantees required by the Specifications, or where applicable, shall share reasonability with the particular manufacturer co-signing the warranty. Any cost related to such warranties shall be included in the contract price. No portion of the work under this Contract shall be considered substantially complete until the applicable warranty and/or guarantee is delivered, in acceptable form, for that work, and all references to substantial completion for purposes of payment or warranty shall be likewise contingent on such delivery.

B. Any repairs, replacements, etc., to be made under the provisions of the aforementioned warranties and/or guarantee shall be made by the KEC at no additional cost to the Construction Manager within three (5) days' notice by the Construction Manager to remedy the defect.

C. Subsequent to the warranty/guarantee periods specified, it any of the defects previously warranted appear, the KEC shall be available for the consultation at any time without cost. He further agrees to remedy any such defect (if so required by the Construction Manager or Owner) at his actual certified cost of such repairs plus 15% overhead and profit.

D. The equipment furnished under this contract shall carry a parts replacement warranty for a period of (1) year from date of start-up of the equipment against defective materials and/or workmanship involved in the manufacture of the equipment and/or as offered by the respective equipment manufacturers. If any part or parts fail during warranty period, the KEC shall ship the parts at no charge to the Owner, providing the defective part is returned for inspection within (30) days from receipt of the replacement part.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Manufacturers: Provide specified equipment and components by one of the following:

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1. Cutting Board: Mapletex, Richlite.White Poly
2. Door and Drawer Pulls: Component Hardware.
3. Door Hinges: Component Hardware..
4. Faucets: Fisher Manufacturing, T&S Brass.
5. Gas Hoses: Dormont or T&S Brass
6. Paint: Krylon, Rust-O-Leum.
7. Refrigeration System
8. Refrigeration Tubing Insulation: Armstrong, Armaflex.

B. Stainless Steel: Austenitic 18-8 Type 304, with a content of 18 percent to 20 percent chrome, 8 percent to 10.5 percent nickel and a maximum carbon content of 0.08, free from scale. Polish surfaces to #4 commercial finish, except where noted.

1. White Metal and Iron Pipe: The use of white metal and iron pipe in lieu of stainless steel is prohibited.

C. Galvanized Steel: Galvanize on eight percent (8%) copper bearing alloy sheet, with hot pure zinc galvanizing complying with ASTM A 525, G90 zinc coating, chemical treatment.

1. Welded Galvanized Steel: Clean seams and remove scale; finished with prime coat of aluminum paint.

D. Stainless Steel Pipe and Tubing: Seamless or welded, gauge specified in schedule, of true roundness complying with ASTM A 554, Type 304 with No. 4 polished finish.

1. Verify tubing is annealed, pickled, ground smooth, and finished to match adjacent work.
2. Welded Tubing: Heat treated and quenched to eliminate carbide precipitation's; drawn true to size and roundness and ground as required.
3. Exposed Tubing: Provide final grind of minimum of 180 grit emery.

E. Miscellaneous Structural Steel Shapes: For angles, band, channels or other structural shapes used for framing, provide uniform and ductile units, free of hard spots, runs, checks, or surface defects.

1. For galvanized or tinned shapes, provide hot dipped galvanized or tinned with fluxes removed. Remove excess spelter from galvanized shapes. Verify shapes are smooth and free from cold runs, blisters, uncoated or scaly patches.

F. Handles, Brackets, Locking Devices, and Hardware: Provide heavy satin finish chrome plated brass, stainless steel, or metallurgical composition of specified item.

G. Locks where specified: Provide extra heavy duty chrome plated cylinder lock for sliding and hinged doors, drawers, enclosed cabinets, refrigerators, storage bins. Master key kitchen locks for doors, drawers, storage bind, and similar equipment.

1. For multiple kitchens, provide each with separate master keying systems.

H. Sealant: ASTM C 920; Type S, Grade NS, Class 25, Use NT. Provide sealant meeting requirements of Food and Drug Administration Regulation 21 CFR 177.2600 when cured and washed in areas where in contact with food.

1. Color: Selected by Architect from standard colors.
2. Backer Rod: Closed cell polyethylene rod stock, larger than joint width.

I. Gaskets: Solid or hollow neoprene or PVC; light gray, minimum 40 Shore A hardness, self adhesive or prepared for either adhesive application or mechanical anchorage. Cellular materials are not permitted.

2.2 ELECTRICAL CHARACTERISTICS AND MOTORS

A. Electrical Requirement: Provide electrically operated equipment listed by the Underwriter's Laboratories, Inc.

B. Plugs:

1. Equip single phase electrical plug-in equipment with 3 wire cords. Supply 3 wire cap with equipment.
2. Equip 3 phase electrical plug in equipment with 4 wire cord. Supply 4 wire cap with equipment.

C. Ground Fault Receptacles: Locate receptacles to conform with National Electrical Code and local jurisdiction. For equipment requiring disconnects. Provide in accordance with the National Electrical Code. Refer to electrical drawings for disconnects. Coordinate providing disconnects with electrical work.

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2.3 COLD STORAGE ROOMS

A. Panel Fabrication

1. Panels shall be pre-fabricated, sectionally constructed and designed for accurate assembly.
2. Panels shall be four inches and shall be completely filled with rigid 100% foamed-in-place Class I urethane between interior and exterior metal "skins" which have been die-formed and gauged for uniformity in size. Slab urethane, high-density rails or wood shall not be acceptable in any panel including doors, walls, floor, and ceiling.
3. The insulation shall have a 97% closed cell structure with an average in-place density of 2.2 lbs. per cubic foot, and a compression strength at yield point of 19 lbs. per square inch.
4. Panels shall be of tongue and groove design with foamed-in-place gaskets for a tight fit and maximum insulation.
5. Corner panels shall be 90 degree angles with coved interiors and actual 12" exterior horizontal measurements.

B. Floors: Unless otherwise specified.

1. Verify that building is transit level prior to installing walk-ins. Floorless on slab: insulation, vapor barrier and thermal break, and final floor finish by General Contractor.

C. Finish:

1. Interior wallsand exposed exterior Per spec. exterior stainless to be 22 gauge stainless steel. If required, Box to have 1/8" aluminum treadplate attached to panel skin and siliconed sealed at all edges as per drawings. Follow written specifications

D. Accessories:

1. 3" X 3" Stainless steel angle trim-10' long.

2. LED light fixtures,
3. Stainless steel closure panels.

E. Assembly of Panels:

1. This shall be accomplished by Posi-locs which shall be foamed-in-place and activated by a hex wrench. Access ports to the locking devices shall be covered by snap caps and shall be located on the interior of the walk-in.
2. N.S.F. listed gasket shall be foamed-in-place (not glued, stapled or nailed) to the male side of all panels, on both the interior and exterior. Gaskets shall be impervious to stains, greases, oils, and mildew.

F. Warranties:

1. Panels to be covered by a ten (10) year warranty.

G. Approvals:

1. Each panel shall have a thermal conductivity (k factor) of .121 BTU/hr./sq. ft. per degree Fahrenheit per inch; and an overall coefficient of heat transfer (u factor) of not more than .030.
2. Fire hazard classification according to ASTME-84 (UL723) shall be a flame spread rating of 25 or less with a certifying Underwriter Laboratory label attached to every panel showing the meeting of the fire code. Urethane panels shall be CFC free.
3. Smoke development rating to be 450 or less; with Factory Mutual approval; N.S.F. listed; and Toxicity rated and approved by U.S. Testing.

2.4 REFRIGERATION AND REFRIGERATION EQUIPMENT

A. When rack system is specified: Outdoor Refrigeration Rack System per specification as follows:

Shall be constructed of 14 gauge galvanized steel with lockable bi-parting doors. Entire frame shall be pre-assembled, welded, cleaned, and painted with a prime coat of DP epoxy-based paint and finished with one coat of Baja Beige polyurethane acrylic enamel.

1. MULTI-CIRCUITED CONDENSER will be sized to operate at an average differential of 20ºF over ambient temperature. Hot air discharge from condenser fans shall be vertical. Fan motors shall not be less than 3/4 H.P. and protected with a rain shield. A venturi contoured air scoop shall be provided for each fan to reduce air turbulence and fan loading. To reduce power consumption, fans shall be equipped with thermal sensing controls mounted inside the control panel designed to operate the minimum number of fans required for adequate air flow under varying ambient conditions. Fan blades shall not be less than 24" diameter and protected with a plastic coated fan guard.
2. Each condensing unit system shall be equipped with an ACCESSIBLE HERMETIC, scroll or DISCUS. Each system shall include dual pressure controls with stainless steel braided hoses (Super-hose), filter drier, sight glass, discharge and suction-line vibration eliminators, flooded head pressure controls and crankcase heater for low ambient control all of which shall be factory assembled and installed.
3. Each condensing unit system shall be equipped with a properly sized receiver tank with pump- down capacity large enough to accept the total liquid volume of refrigerant without exceeding 80 percent of its volumetric capacity. Each receiver shall be equipped with inlet and outlet isolation valves with service ports.
4. Refrigerant shall be current DOE requirement used for medium temperature systems and for low temperature systems.
5. ELECTRICAL CONTROL PANEL: The refrigeration system shall have an external factory-mounted and pre-wired (NEMA 3 EQV.) electrical control panel complete with an industrial grade interlocked main-fused disconnect with separate compressor and fan motor circuit breakers, contactors and defrost time clocks for single point power connection. Each internal wire shall be color-coded and numbered. The numbers of each individual wire shall

be noted on the wiring diagram. A wiring schematic photo-etched onto a .012 aluminum plate shall be permanently affixed inside of the control panel.

6. PRE-PIPING: All refrigerant lines shall be type "L" tubing and extended to one side of the package in a neat and orderly manner with ends of lines capped and identified by system using photo-etched tags. All tubing shall be securely supported and anchored with uni-struct channel and clamps with Neoprene Grommets. Suctions lines shall be wrapped and insulated to prevent condensate accumulation. All piping shall be pressure-tested at the factory with nitrogen at 150 psi for low side and 400 psi for high side. All systems shall be shipped from the factory with a 25 psi holding charge.
7. EVAPORATOR COILS**:** The evaporator coils as specified by the R-1 drawing shall include a compressor BTU matched low-profile end mount evaporator coil. Each evaporator coil shall include liquid-line sub-cooling circuit, thermostat, balanced port expansion valve and liquid- line solenoid valve all mounted and wired, as required, at the factory.
8. RATING PLATE IDENTIFICATION, WIRING SCHEMATIC AND NAMEPLATE: Rating plate identification made of aluminum plate shall be permanently affixed to the outside of the system and include the following information as per U.L. standard 303:

    a. System Model and Serial Number.
    b. Electrical power supply, minimum circuit ampacity and Maximum Fuse Size.
    c. Electrical data for Condensing Units, Evaporator Coils and Condenser Fan Motors.
    d. Individual System Identification and Horsepower.
    e. Type of Refrigerant.
    f. Control Number

        1) Wiring Schematic. A wiring schematic photo-etched onto .012 aluminum plates shall be permanently affixed inside the control panel.
        2) Nameplates. Separate nameplates photo-etched onto .012 aluminum plates shall be affixed toidenify condenser and fan motor circuit breakers, remote fan moto

    g. capacitors, thermal sensing fan cycle controls, and time clocks. These nameplate shall be located above or below each item inside the control panel.

9. INSTALLATION:

    a. Refrigeration Contractor: The installing Refrigeration Contractor shall obtain all permits, mount evaporator coils, provide and install refrigerant piping, fittings, hangers, support, hook-up and start-up as per manufacturers Preparation and Start-Up Procedure. The Preparation Start-Up Procedure should be filled out, signed and returned to Manufacturer within ten (10) days of start-up. All copper tubing shall be refrigerant grade type "L". Sil- fos 15 shall be used, not soft solder. After the system and unit cooler have been connected, the balance of the system shall be leak-tested with all valves open. The complete system shall be evacuated with a vacuum pump. Each system shall be charged with the refrigerant as specified in the Manufacturer Engineering Summary. The Contractor shall be responsible for test and adjustment of each condensing unit to make the total system operational.
    b. Electrical Contractor. Electrical Contractor (E.C.) shall provide main power for refrigeration package and all control and defrost wiring as called for in the Manufacturer wiring diagram. E.C. shall also connect drain-line heater in freezer. All electrical wiring installation shall be in accordance with the Manufacturer wiring diagram and local codes.
    c. General Contractor. The General Contractor shall provide the following:

        1) Verify all dimensions and coordinate with all other trades.
        2) Provide and prepare the pitch-pans and platform or rails as called for in the R-1 drawing.
        3) Complete weatherproofing around and under unit.
        4) On-site concrete coring for refrigeration piping.
        5) Crane or hoist services as required for placement of the refrigeration unit and/or other required materials.

d. Plumbing Contractor: shall provide type "L" copper drain-lines for walk-in refrigerator and freezer, pitched 1/4" per foot of run. Drain line shall be "P: trapped outside of refrigerated space to avoid entrance of warm, moist air or vermin. Contractor shall provide individual drain lines, with Electrical heat tape for each evaporator coil unless otherwise specified in the R-1 drawing. All plumbing installation shall be in accordance with local codes.

B. When non-rack system is specified:

1. Compressors: Heavy duty, noiseless unit with required starting switches and supplied by approved manufacturer. Provide complete with copper tubing dehydrated and sealed at time of installation with pressure switches, line dryers, dehydrators and sight glasses.

   a. Fully wrap and adequately support refrigerant lines extended from compressor locations to individual units. Individually run suction and pressure lines and individually wrapped with fire rated wrap.

2. Motors: Accessible hermetic type utilizing suction gas cooled motor principle with built-in thermal and electric overload protection in motor compressors. Supply each motor with thermal breaker switch installed.

   a. Provide motors with contactor's definite purpose type. Install contactors on surface free of excessive vibration in electrical enclosure on rack unit.

3. Refrigeration System: Balanced, remote, packaged, internally prewired, and pre-piped, pressure tested, and pressure sealed systems designed to accommodate specified refrigerated equipment requirements. Provide complete system including, but not limited to:

   a. Evaporator coil assemblies.
   b. Condensing unit assemblies,
   c. Motor starters.
   d. Refrigerant piping.
   e. Insulation
   f. Temperature controls
   g. Related fittings, gauges, valves, regulators, refrigerant, and oil requried for a complete operating system.

4. Evaporator Coil Assemblies: Provide coil, fan, drain pan, expansion valve, temperature control, heat exchanger, and standard components. Furnish coil units to equipment manufactures required for mounting in equipment during fabrication or installation.
5. Refrigeration Tubing: Provide Type L,AC hard draw degreased, sealed copper with horizontal runs sloped 1" per 20 feet toward refrigeration circuit or to local code. Support refrigerant piping with adjustable hangers spaced and adjusted to drop required. Where vertical runs of more than 5 feet occur in suction line, trap riser at bottom. Install piping so refrigerant or oil cannot drain back into coils from suction line.
6. Insulation: Insulate refrigerant lines with minimum ½" thick fire rated foam insulation for medium temperatures and ¾" thick fire rated foam insulation for low temperatures or equivalent cellular type insulation. Joints between section of insulation shall be glued and taped.

   a. Provide metal pip sleeves where piping passes through wall, ceiling, or floor. Fill space around tubing with mastic insulation compound.
   b. Utilize EPA and DOE approved refrigerant

7. Drain Line: Coordinate PC to supply Type L supported copper drain line from each coil outlet, 1" away from surfaces to a point 1" above floor sink where shown on rough-in plan provided under other work. Verify brass union and clean-out connection at coil outlet to allow repair, service, and verify replacement has been installed under other work.

a. Immediately trap drain lines above floor sink.
b. Paint exposed drain lines with 2 coats chrome paint.
c. Verify freezer drain line has been wrapped with continuous electrified heater tape provided by EC.

8. Valves: Provide approved standard weight valves suitable for service and purpose intended.

a. Expansion Valves: Installed in refrigeration liquid line where entering evaporator. Provide external equalizer expansion valves for coils fitted with refrigerant distributor.
b. Solenoid Valves: Provide line voltage, manual lift system type to operate at maximum 2 point pressure drop across valve; of full refrigerant line size, using silver solder connections as applicable.

1) For normally closed liquid line solenoid, provide with temperature controller for each coil on system.

9. Dehydrator or Dryer: Provide at compressor assembly. Install in liquid line.

10. Pressure: Pressurize systems to manufacturer requirements and local code. test for leaks.

a. Perform testing on insulated piping prior to application of insulation.
b. After testing, establish deep vacuum of 29 inches or 50 microns and hold for 24 hours minimum, with maximum decrease of 3 inches of vacuum. Assure evacuation time is adequate for removal of internal moisture.

2.5 FAUCETS, VALVES, FITTINGS, AND ACCESSORIES

A. Furnish faucets, rotary handle wastes, basket wastes, open wastes, and strainers for installation by others.

B. Faucets: For each sink, provide faucet with ball check to prevent cross flow of hot and cold water.
1. Specialized Faucets: Specified under item where intended for use.

C. Gas Fired Equipment: At initial installation, PC to provide gas fired equipment with proper gas pressure

D. Finished: For exposed to view accessories, PC to provide chrome plated piping, fittings, escutcheons, valves, supports, hangers, and similar accessories installed in conjunction with kitchen equipment. Accessories painted with dull aluminum spray paint are acceptable.

1. Exposed to view applies to piping from the point piping leaves the wall, ceiling, or floor construction to the point of final connection to kitchen equipment or fixtures.
2. Piping built into fixed counter with concealing doors is not considered exposed.

2.6 FABRICATION

A. Welding: Perform welding using electric fusion metal arc method. Carbon arc or gas welding is not permitted. Perform welding with welding rod of same composition as sheets or parts welded. Make welds complete, strong and ductile. Grind off excess metal from joints and finish smooth to match adjoining surface. Provide welds free of mechanical imperfections (gas holes, pits, runs, cracks, similar) and of same color as adjoining surfaces.

1. Weld joints in tops of fixtures, tables, drainboards, exposed shelving, sinks, and similar items. Continuously butt weld equipment construction of more than 1 piece of sheet metal. Grind welds smooth and polish.

2. Provide welded joints homogeneous with sheet metal. Where sheet sizes necessitate a joint, weld joint. Fabricate tops of fixtures in factory with welded joints to reduce field joints to a minimum. Where fixtures join, continuously weld top of fixture joints, except for field joints.

    a. Field Joints: Closely butt, pull together, field weld, grind and polish smooth.
    b. Tops of Fixtures: Fabricate to a maximum length with welded factory joints to bring fixtures to final position and reducing field joints to minimum. Where welds occur on surfaces and are not finished by grinding and polishing, factory coat welds and discolored areas with metallic base paint to prevent progressive corrosion to joints.

3. Soldering and brazing: Soldering and brazing stainless steel surfaces which can be welded is not acceptable.

B. Grinding, Polishing, and Finishing:

1. Grind welded exposed joints flush with adjoining material and neatly finish to harmonize with surrounding area. Where material is sunken or depressed by welding operation, grind depression and peen flush to adjoining surface. If necessary, again grind to eliminate low spots. Polish and buff ground surfaces to match adjoining surfaces consistent with good workmanship.

    a. Exercise care in grinding operations to avoid excessive heating of metal and metal discoloration.
    b. Remove grain or rough grinding by successive polishing operations.
    c. Verify texture of final polishing operation is uniform and smooth.
    d. Provide high grade finish for equipment

2. Butt Joints: Confirm code allowance requirements. Make butt joints and contact joints close fitting, not requiring solder as filler.

    a. Soldering where dependence is placed solely on soldering for strength and stability of joint or fixture is not permitted.
    b. Where brake bends occur, make free of under extrudence. Where brakework mars uniform appearance of material, remove marks by grinding, polishing, and finishing.
    c. Where sheared edges occur; make free of burrs, fins or irregular projections. Finish sheared edges.
    d. Where miters of bull nosed corners occur, neatly finish with under edge of material ground to uniform condition. Overlapping materials is not acceptable.

3. Provide equipment with quality finish, consistent with high grade manufacturing practices and free of sharp edges or corners.

    a. Exposed surfaces: Provide #4 finish. Exposed surface includes inside surface exposed to view when sliding or swinging door is opened. Finish underside of shelf equal to #180 ground finish. Final #4 finish is factory finish not finish furnished by mill. Indications of die markings not blending with final finish are not acceptable.

C. Corrosion Protection:

1. Where welding operation occurs on stainless steel, take measures to eliminate possibility of corrosion. Weld bolts and screws using industry standard process that eliminates possibility of carbide precipitation. Finish each welded joint in bright finish to eliminate progressive corrosion. Grind or coat underside of each weld to prevent possibility of

oxidation and progressive corrosion.

2. Welding performed by process which eliminates or reduces carbide precipitation in connection with bolts and screws need not be treated. Treat welded joints to prevent progressive corrosion.
3. Where welded framing, or galvanized or tinned angle or channel construction is specified, perform welding prior to hot galvanizing. If galvanized structural sections are used, treat welded joints with metallic coating to cover surfaces marred by welding and grinding operations. Clean iron or galvanized pipe and other parts and finish in the factory with minimum 2 coats of NSF approved gray spray.

D. Bolt Construction:

1. To the extent possible, provide exposed surfaces free of bolts, screws and rivet heads. Where bolts are used to fasten trim to paneling or body of warmers, cabinets, counters, similar items, and to fasten tops of counters, dish tables to top of framing, use concealed type bolts and screws
2. Where threads of bolts and screws occur on inside fixtures, are visible, or might come in contact with hands or wiping cloth, cap bolts and screw threads with lock washer and chrome plated brass or bronze acorn nut. Where screw threads are not visible or readily accessible, cap with standard lock washer and steel nut treated to prevent rusting or corroding.
3. Where bolts or screws are welded to underside of trim or tops, finish reverse side of weld uniform with adjoining surface of trim or top. Depressions are not acceptable.

E. Counter Legs: Provide heavy duty, stainless steel legs.

F. Leg bracing: Provide bracing from front to back, forming H frame. Construct from minimum 1-5/8 inch
o.d. x .083 inch stainless steel tubing except as noted. Run cross bracing horizontal and level between legs, approximately 10 inches above floor, unless otherwise specified. Completely weld joints around entire perimeter forming complete seal with welds ground and polished smooth to match adjacent work.

1. Rear Bracing: Interconnect H frames or, if required, provide rear single bracing for dish tables, space for bins, carts, or mobile equipment. Secure to adjacent legs with welded joints.

G. Leg Mountings: Where units are mounted on legs 14 inches or longer, provide underbracing.

1. Provide legs with sanitary type 12 gauge stainless steel inverted type channel braces full width of respective tops. Channel width: approximately 2-3/4 inches

   a. Vertical Channel legs: 1 inch with 7/8 inch wide flange; overall width of channel is 4-1/2 inch. Round ends of channel and fully enclose by welded stampings matching cross section of channel.
   b. Channel: Projection weld to underside of stainless steel units at intervals of maximum 4 inches and at ends maximum 2 inches on center. Fully close crevices between flanged channel and underside of unit and sealed off with filler. Provide channel braces receiving supporting legs concentric with legs.

2. Weld stiffening cup in contact with underside of unit and welded to inside of channel. Provide 1- 3/8 inch o.d. pipe 3-1/2 inches long and weld inside to bottom of channel concentric with legs and centered.

   a. Pressure force 1-5/8 inch o.d. pipe over welded pipe and hold in place with ¼ inch oval head stainless steel bolt with lock nut. Verify leg fits tightly against underside of channel, preventing entry of vermin or dirt. Where underside of units are wood construction, bolt channel braces to underside and seal resulting joints with filler.

H. Underbracing: Brace stainless steel counters, tables, drainboards, and dish table tops with

inverted type channels, spaced maximum 30 inches on center. Provide channels with double sided tape applied to top of channel meeting top.

I. Feet: Provide legs with stainless steel bullet feet, having integrally formed shaft, with minimum adjustment of approximately 1-1/2 inch without use of threading or adjusting bolts. Completely seal feet at bottom and fit closely between tubular leg support and foot. Construct feet in accordance with NSF standards.

J. Undershelving:

1. Flat Undershelving: Constructed from 18 gauge polished stainless steel. Turn down sides of shelving approximately 1-1/2 inches and under ½ inch, 70 degrees, in channel shape with resulting corners cut out to fit contour of leg. Weld shelving to legs. Reinforce undershelving with 1" x 4" x 1" 14 gauge stainless steel welded channels.
2. Construct removable types of shelving of same material, rolled down on all sides, with corners notched to contour of leg, with resulting notches ground and polished smooth. Construct undershelving in sections of maximum 36 inches. Where butted against adjoining shelf section, turn down shelving 1-1/2 inch and under ½ inch in channel shape. Provide supporting channel on underside of each shelf section, of size and material specified.

K. Drawers: Set drawers into enclosed 18 gauge stainless steel vermin proof housing, closed on all sides and bottom, with 12 gauge stainless steel channel shaped slides, 4 stainless steel ball bearing rollers, 2 front and 2 rear, auto stops and release catches. Sound deaden drawers.

1. Drawers: 20" x 20" x 5" deep inside dimensions unless otherwise specified.
2. Drawer Inserts: Construct of composition rubber or stainless steel
3. Drawer Fronts: Minimum 16 gauge stainless steel, double pan type, with resulting corners welded, ground and polished smooth. Provide drawer faces with recessed stainless steel pull handles welded to face.
4. Bottom of Housing: Where required, provide additional stainless steel angle guides to accommodate 20" x 20" x ¾" thick white acrylic cutting board with pull handle.

L. Water Inlet Location: Locate above positive water level to prevent siphoning of liquids into water system.

M. Sinks and Drainboards:

1. Construct sinks and drainboards of 16 gauge polished stainless steel with joints welded, ground and polished smooth. Soldering is not permitted in sink and drainboard construction. Extend front and freestanding edges upward 3 inches measured at sink edge and rolled rim 1-1/2 inch horizontally and down 1-1/2 inch

    a. Verify raised rim at front and ends of drainboard is level and continuous with sink rim and does not follow pitch of drainboard.

2. Round vertical and horizontal corners to radius of approximately 1 inch with intersections meeting in spherical sections.

    a. For sinks having 2 or more compartments construct double dividing partitions, with fully rounded corners, both vertical and horizontal.
    b. Round corners of drainboards on inside to radius of 1 inch where rolled rim meets front roll rim.
    c. Round back splash on all inside to radius of 1 inch.
    d. Fully round front corners of rolled rim on outside roll concentric with inside of roll.
    .

3. Drainboards: Pitched drainboard 1/8 inch per foot toward sink compartments. Provide sinks and drainboards with 8 inch high back splashes, level and continuous, not following

pitch of drainboards adjacent to walls or adjoining equipment.

a. Bottom: Crease bottoms to sufficient pitch toward waste outlets.
b. Cut openings for hot and cold water faucets into back splashes as required. Construct sinks 12 inches deep unless otherwise specified or indicated on drawings.
c. Finish exposed exterior and interior of sinks and drainboards to #4 satin finish.

4. Sinks: For sinks integral with counters, as indicated on plans, same as sinks, weld into place with resulting welds ground and polished eliminating all traces of welding.

a. Sink Bottom: Provide of each sink compartment with 2 inches I.P.S. heavy duty, lever drain, constructed with removable poppet valve, in addition to neoprene "O" ring, affording double security against leakage.
b. Lever Handles: Construct to adequate length so rod handle will not protrude beyond sink top.. Furnish waste outlet with stainless steel strainer plate for pot sinks having overflow compartment. For sink compartments with no overflow , provide with lever drain complete with stainless steel strainer plates.
c. Where 1-1/2 inch outlet connections are indicated, provide drains with adapter and removable crumb cup strainer baskets. Unless otherwise noted, construct connected overflow with steel perforated plates secured to body of sink so constant water level is 1 inch below dividing partitions.

5. Pre-rinse Sinks: Construct the same as sinks. For sinks without Garbage disposals, Provide with perforated baskets of minimum 18 gauge polished stainless steel of suitable mesh and arranged to strain out solids from rinse water. Arrange baskets to be easily removed. Provide basket with suitable handle(s).

a. For removable type dish slides and guides, provide with frame and cross bars of minimum 1" x ½" stainless steel, resting on angle channel on 4 sides of sink and supporting set of minimum 1" x 1" x 1/8" stainless steel angle slides, arranged and set flush with top of dish tables.
b. If other slides and glides are used, provide details with base bid.

6. Pre-rinse Faucet Assembly: Provide with each pre-rinse sink. Provide complete faucet and assembly with flexible metal design,
a. Equip unit with jacket valves to prevent cross flow or back flow of water.
b. Provide unit with squeeze type faucet control for power spraying. Construct interior of mechanism of stainless steel. Provide with wall type supporting bracket.

N. Stainless Steel Counters:

1. Tops: Minimum 16 gauge single piece polished stainless steel finished in #4 satin finish, with resulting edges rounded with no burrs or excess material. Turn down edges 2 inches at 90 degree and under ½ inch in channel shape on exposed sides with 1-1/2 inch overhang.

a. Where counters are placed against walls, turn up back and ends 6 inches, return back 2 inches @ 45 degree angle, and down ½ inch for securing to wall with exposed ends closed, welded and polished smooth.
b. Cove vertical and horizontal joints ¾ inch radius, terminating in fully coved intersections fully welded, ground and polished smooth to match the top surface.
c. Reinforce underneath with inverted type channel of minimum 14 gauge stainless steel, spaced maximum of 30 inches o.c. for tables 6'0" and longer, provide 1-1/2" x 1-1/2" x 1/8" thick stainless steel angle framework reinforcing edge, with cross channel every 30 inches or less.

2. Body: Minimum 18 gauge polished stainless steel finished in #4 finish, with resulting edges rounded with no burrs or excess material.

a. Minimum 2 inch wide vertical mullions turned back 1 inch

3. Shelves: Minimum 18 gauge polished stainless steel finished in #4 satin finish, with resulting edges rounded with no burrs or excess material.

a. Turn down front edge of intermediate 1-1/2 inches at 90 degrees and back ½ inch @ 45 degrees.
b. Turn down bottom shelf 1-1/2 inch at 90 degrees with ½ inch back @ 45 degrees.
c. Back and ends of shelves turn up 2 inches at 90 degrees with ¾ inch radiused cove at horizontal and vertical intersections fully welded, ground and polished to match shelf surface.

4. Legs: Heavy-duty stainless steel with adjustable stainless steel feet.

O. Work Counter or Table Top Sinks:

1. Construct sinks of same gauge and material as counter tops. Continuously electrically weld top perimeter of sink to edge of opening in table or counter top. Grind and polish smooth resulting welds so sink and top are integral units. Die punch table or counter top to ¾ inch faucets.
2. Round vertical and horizontal corners to 1 inch radius with bottoms pitched to 1-1/2 inch or 2 inch waste outlet as indicated on plan.
3. Hang work counters and tabletop sinks by hanger clips.
4. Match finish and appearance of sinks with table or counter top.

P. Stainless Steel Table Tops: Minimum 16 gauge polished stainless steel finished in a #4 satin finish, with resulting edges rounded with no burrs or excess material. Turn down tops 1-1/2 inches and under ½ inch in channel shape on exposed sides. Where tables are placed against walls, turn up in back approximately 6 inches, returned 2 inches at 45 degrees to wall with exposed ends closed, welded ground and polished smooth.

1. Cove vertical and horizontal joints on ¾ inch radius, terminating in fully coved intersections thoroughly welded, ground and polished smooth to match top surfaces.
2. Tops: Construct of single pieces of stainless steel and reinforce underneath with inverted type channel of minimum 14 gauge stainless steel, spaced maximum 30 inches o.c.

a. For tables 6’0” and longer, provide 1-1/2” x 1-1/2” x 1/8” thick stainless steel angle framework reinforcing edge, with cross channels every 30 inches or less.

Q. Insets: Minimum 18 gauge stainless steel fully coved. Provide full complement of insets with covers, of sizes and patterns specified, with equipment as necessary. Insets include but not limited to stainless steel pans. Additional covers are provided by owner.

R. Elevated Shelves: 18 gauge polished stainless steel with working side turned down 2 inches and under ½ inch in channel shape with resulting corners welded, ground and polished smooth. Turn up ends and back approximately 2 inches. Round upturned edges at ends and in front and finish smooth.

1. Mount shelves on minimum 12 gauge stainless steel cantilever brackets secured to wall by means of chrome plated toggle bolts and expansion shields.
2. Position brackets 3 inches clear of wall at ends.

S. Sliding Doors: 18 gauge polished stainless steel exterior and 20 gauge stainless steel interior. Equip doors with die stamped recessed stainless steel pull handles. Provide removable doors constructed of double pan construction, filled with sound deadener ½ inch thick with corners welded, ground and polished smooth to uniform finish.

1. Construct doors to permit removal for cleaning or adjustment without use of tools. Keep bolts and screws to minimum and of corrosion resisting metal.

2. Spacers (Not Exposed To View) 14 gauge ¾ inch diameter; with upper suspension stainless steel rollers to be heavy duty and ground to minimize wear and noise. Take precaution to avoid friction or rubbing between doors, door suspensions and upper sliding framework, including hardware.
3. Double Doors: Provide with double overhead tracks and carriers for maximum clear door opening. Provide units with trackless bottom with concealed guide for overhead roller doors. Equip guides with limit stops to prevent telescoping of doors.

T. Hinged Doors: 18 gauge polished stainless steel front with 20 gauge stainless steel pan shaped backs, with corners welded, ground and polished smooth.

1. Hinges, Catches and Locking Devices: Chrome plated brass.
2. Hinges: Stainless steel lift off type construction to eliminate exposed bolts and screw heads.
3. Door Handles: Stainless steel, flush mounted. Locking devices as indicated.
4. Hinges: Stainless steel lift off type.

U. Counter Shelves, Cabinet Shelves, and Overhead Cabinet Shelves: 16 gauge polished stainless steel.

1. Overhead Cabinet Shelves: 18 gauge polished stainless steel.
2. Shelving: Removable type, finish in #4 satin finish and constructed in sections of maximum 30 inches. Where shelves are higher than 5’0” above floor, finish underside of shelf same as top. Fabricate shelves to be removable for cleaning, except where specified as fixed. Perforate warmer shelves and construct as removable.

V. Angle Mountings: Provide fixed equipment adjacent to walls with front legs and rear wall mounting.

1. Provide stainless steel tables adjacent to walls with 6 inch high back splashes, returned 1-1/2 inch to wall with welded closed ends.
2. Support return of tops with 1” x 3”, 12 gauge stainless steel angle, fastened to wall with lead shields and chrome plated lag screws.

W. Wall Cabinets: Provide wall cabinets in lengths indicated on plan or length specified x 13 inches deep and 36 inches high, except where shown otherwise on drawings. Provide sloped, dust proof tops. Construct exterior bottoms to be flush type.

1. Construct from 18 gauge polished stainless steel, all welded construction. Provide cabinet interiors with fixed bottom shelf and 2 removable, adjustable, intermediate shelves. Rest shelves on clips secured to stainless steel keyholes strips fastened to interior of cabinet.

X. Floor Troughs:

1. Trough: floor troughs to be 14 gauge type 304 stainless steel in #4 finish. Troughs to be fabricated to accommodate Stainless steel or Chemgrate Chemtread grates. Troughs to be a minimum of 4” deep pitched ½” per foot of length to 4” drains. Drains to be located a minimum of every 12’0”. Maximum length of trough pitch to be 6’0”. Troughs to have ¾” fully coved, welded and polished corners. Each drain shall have a removable perforated stainless steel basket held in a stainless steel waste cup. Profile of top edge as per plans. Coordinate height of finished floor with General Contractor and fabricate frame accordingly. Trough must be flush with finished floor.

2. Grate: Chemgrate gratings follows:

a. The tread shall be fiberglass roving reinforced polyester 1-1/2” high, having a grid pattern with bearing bars 1-1/2” and cross bars 6” on center.
b. The tread shall be made in a mold and of single piece construction so the reinforcing glass of the bearing bars are interwoven with the reinforcing glass of the cross bars. The solid nose construction shall be made integral with the tread and shall be 1-3/4” wide.

c. Angular white silica particles shall be integral molded in the top portion to provide an anti- slip walking surface.
d. All grates to be maximum length of 48-1/2". Any grates shorted than 48-1/2" shall be cut flush at a cross bar.

3. Floor troughs to be provided by KEC and installed by GC unless otherwise noted

Y. Shipping:

1. Totally assemble all equipment at factory before shipping and delivery.
2. Mark all disassembled equipment.
3. Properly number.
4. Provide drawings and instructions for re-assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Rough In Work: Examine roughed in utility services, installation of floors, walls, columns, and ceilings, and conditions under which food service work is to be installed; verify dimensions of services and substrates before fabricating work. Notify Architect of unsatisfactory locations and dimensions of work and of unsatisfactory conditions for proper installation of food service equipment. Do not proceed with fabrication, purchasing and installation until unsatisfactory dimensions and conditions have been corrected.

B. Accessories: Verify accessory items required have been provided.

3.2 INSTALLATION

A. Provide all labor, materials, equipment, services and transportation required to furnish, set in place and make ready for final utility connections by others all food service equipment. Note: Existing equipment will be disconnected and set-in-place by contractor.

B. Install equipment in accordance with manufacturer's instructions and recommendations.

C. Receiving and Installation of exhaust hoods and floor troughs by General Contractor.

D. Set each item of non-mobile and non-portable equipment securely in place, level, and adjust to correct height. Anchor to supporting substrate where indicated and where required for sustained operation and use without shifting or dislocation. Conceal anchorage's where possible. Adjust countertops and other surfaces to level tolerance of 1/16 inch maximum offset, and maximum variation from level or indicated slope of 1/16 inch per foot.

E. Where indicated or required for safety of equipment operator, anchor equipment to floor or wall. Where equipment is indicated to be anchored to floor, provide legs with adjustable flanged foot. Install 2 anchors on each foot.

F. Free Standing Equipment: Place units in final location after finishes have been completed in each area. Verify clearances are adequate for proper operation of equipment.

G. Field Joints: Complete field assembly joints in work (joints cannot be completed in shop) by welding, bolting and gasketing, or similar methods as indicated. Grind welds smooth and restore finish. Set or trim gaskets flush, except for T gaskets as indicated.

H. Closure Plate and Strips: Install where required, with joints coordinated with units of equipment.

I. Cutouts: Provide cutouts in food service equipment where required to run plumbing, electric, gas, or steam lines through equipment items for final connections.

J. Sealant and Gaskets: Install around each unit to make joints airtight, watertight, vermin proof, and sanitary for cleaning purposes. Make sealed joints minimum 1/8" wide and stuff backer rod to shape sealant bead properly at ¼" depth.

3.3 FIELD QUALITY CONTROL

A. Testing: Start up and calibrate food service equipment after service lines have been cleaned, tested, balanced, and adjusted for pressure, voltage, and similar considerations. Do not operate steam lines until cleaned and treated for sanitation. Before testing, lubricate each equipment items in accordance with manufacturer's recommendations.

B. Start-up, check, adjust, and calibrate equipment furnished and installed. Repair or replace equipment and parts that do not function properly.

C. After equipment is operating properly, schedule with the Owner's Food and Beverage and Engineering Personnel a demonstration of equipment operation, cleaning and maintenance.

3.4 CLEANING

A. After completion of installation and major work in food service areas, remove protective coverings and construction clean food service equipment, internally and externally. Restore exposed and semi-exposed finishes to remove abrasions and other damages; polish exposed metal surfaces and touch up painted surfaces. Replace work that cannot be successfully restored.

B. Final Cleaning by Owner: After testing and start-up, and before Substantial Completion inspection, clean and sanitize food service equipment, and leave in condition ready for use in food service.

C. Legally remove and dispose waste and surplus material, and rubbish from site.

3.5 CLOSEOUT PROCEDURES

A. Contract Closeout Procedures: Submit written certification that Contract Documents have been reviewed, work inspected, and work has been completed in accordance The Contract Documents, and ready for inspection.

B. Provide services of Installers technical representative, and manufacturer's technical representative where required, to instruct Owner's personnel in operation and maintenance of food service equipment.

C. Schedule training with Owner; provide at least 7 day notice to Architect of training date.

D. Tag all keys and turn over to owner.

E. Project Record Documents: Maintain on site, 1 set of Contract Documents, Shop Drawings, and Product Submittals to be utilized for record documents.

1. Record actual revisions to the work concurrent with construction progress.
2. Specifications: Legibly mark and record at each section, a description of actual products installed.

F. Record Documents and Shop Drawings: Legibly mark each items to actual construction.

1. Submit documents.

G. Warranties: Execute and assemble documents from subcontractors, suppliers, and manufactures.

3.6 EQUIPMENT SCHEDULE

A. See drawings.

END OF SECTION

SECTION 11 66 00
ATHLETIC EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Work of this section includes, but is not limited to the following: Include, in the bid, for each item listed, all labor, materials, equipment costs and miscellaneous items required for a complete installation.

B. Provide fixed and portable athletic equipment and items as shown on the drawings and in the specifications.

C. Provide brackets, hangers, supports, pedestals and anchorage necessary to mount or suspend equipment in a neat, safe and permanent manner.

D. Products include:
   1. Structural basketball supports at the gym.
   2. Motorized curtain divider (Gym).
   3. Retracting Basketball backstops electric backstop adjusters, backboards, goals and nets. (Gym)
   4. Stationary Basketball backstops, manual adjusters, backboards, goals and nets. (Kid's Gym)
   5. Wall Padding:
      a. Wall fittings.
      b. Interior Wall padding.
      c. Exterior Wall padding.
      d. Protective guards.
   6. Alpha Rack Divider Panels.
   7. Ballet bar and mounting brackets:
      a. Wall Mounted.
      b. Floor Mounted.
   8. Tumbling Equipment:
      a. Trampoline and Landing Mat.
      b. Gymnastics Equipment.
      c. Rings.
      d. Single Bar.
      e. End Block.
   9. Foam Bonded Carpet.
   10. Traverse Wall.

1.02 RELATED SECTIONS

A. Division 00 - Procurement and Contracting Requirements, Contract Forms and Conditions of the Contract.

B. Section 01 33 00 - Submittal Procedures.

C. Section 01 40 00 - Quality Requirements.

D. Section 01 60 00 - Product Requirements.

E. Section 01 92 00 - Facility Operation and Maintenance.

F. Section 05 40 00 - Cold Formed Metal Framing.

G. Section 05 50 00 - Metal Fabrications.

H. Section 06 10 00 - Rough Carpentry.

I. Section 08 81 00 - Glazing.

J. Section 09 21 16 - Gypsum Board Assemblies.

1.03 RELATED REQUIREMENTS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

B. NCAA (BR) - Men's and Women's Basketball Rules and Interpretations; current edition.

C. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2023, with Errata.

1.04 SUBMITTALS

A. Product Data: For each item specified, including attachments and installation data.

B. Shop Drawings: Show details of fabrication and installation, including dimensions and location of each item. Provide details for anchoring and show relationship with, attachment to and reception of related items.

C. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.
   3. See Sections 01 33 00 and 01 60 00.

D. Operation and Maintenance Data: Submit O&M manuals according to the requirements of Section 01 92 00 - Facility Operation and Maintenance.

1.05 QUALITY ASSURANCE

A. Manufacturer: Minimum of five years successful experience in the manufacturer of the type of respective product specified. Manufacturer shall be represented by a local agency to provide maintenance and service of specified equipment.

B. Equipment shall be provided by a single source manufacturer in order to establish and assure a consistent warranty/service policy.

C. Installer: Minimum of three years successful experience in installation of the type of respective items specified.

1.06 DELIVERY, STORAGE AND HANDLING

A. Items shall be delivered to Project site in undamaged condition.

B. Do not deliver items to Project site until building is enclosed, other Work within the spaces is substantially complete and installation of all items within that space is ready to begin.

C. Store as recommended by manufacturer’s written instructions and in original protective packaging until time of installation.

1.07 OPERATION

A. Instruct Owner’s personnel in proper operation of items as necessary. Provide operating and maintenance manuals.

1.08 REFERENCES

A. All equipment shall conform to the latest rules and regulations of the National Federation of State High School Association (NFSHSA) and the National Collegiate Athletic Association (NCAA (BR)).

B. Submit manufacturer’s Certificate of Insurance.

1.09 WARRANTY

A. Provide one-year warranty against defects in materials and workmanship. Provide lifetime warranty on all backboards. Backstop structure without said warranty will not be approved as equal. Extended Warranties shall be in force on other items as listed in product specifications.

PART 2 PRODUCTS

2.01 EQUIPMENT

A. Refer to manufacturer’s latest printed specifications for details not covered herein.

B. Gym Divider:
   1. Provide and install one of the following:

a. Fold-Up Gym Divider as manufactured by Draper, Inc. Spiceland, IN.
b. Model 4020 as manufactured by Performance Sports Systems/Gared Sports, Noblesville IN.
c. Or approved equal.

2. Verify site conditions and dimensions prior to manufacture.
3. Lower Section: Solid vinyl coated polyester, 18 to 22 ounces per square yard, to 8'-0" high, containing antibacterial, fungi-resistant and flame retardant chemicals (Fed. Std. 191, method 5903-T) an listed and approved by the California Fire Marshal.
   a. Color: Forest Green.
4. Upper Section: 9 ounce per square yard, vinyl coated polyester type interlocking grid weave with approximately 45-50% open area. Flame resistant per California Fire Marshal Regulation No. F 102.4.
   a. Color: Black.
5. Top curtain to be fabricated with pocket to conceal a continuous 1 5/8" O.D. steel tube extending the full length of the curtain.
6. Bottom curtain edge to have pocket to accommodate a 1 5/8" O.D. steel tube extending the full length of the curtain.
7. Roof Support Suspension: Shall be by clamp-type malleable lug fittings supplied by curtain manufacturer.
8. Hoist Lines: 1/8" O.D. vandal resistant galvanized cable (1,800 lbs. breaking strength, each cable, spaced not to exceed 12'-0" o.c.). Each line shall be attached to bottom tube and run through grommets set at 18" o.c. Each line shall be attached to a drive pipe at the top of the curtain. Drive pipe shall rotate in a support assembly equipped with four (4) steel ball bearing wheel rollers.
9. Drive Pipe: ¾ hp, 115 V, 60 cycle, 1 phase, reversible capacitor, C-faced gear motor with automatic overload protection. Gear reducer filled with oil overload protection. Gear reducer shall be filled with oil and be equipped with high-quality lip seals. For curtains larger than 3,000 SF, a double reduction (75 tol) gear motor with integral 6 ft/lb brake mechanism shall be provided.
10. Remote Control: Include integral limit switch to control upper and lower limit of travel.
11. Key Switch: 3 position momentary contact wall switch with safety delay. Stainless Cover Plate for flush mounting in junction box provided by Electrical Contractor.
12. Electrical: Wiring of all electrical components shall be in accordance with local codes and manufacturer's instructions. All conduits, wiring, junction boxes and components not specified herein shall be furnished and installed by the Electrical Contractor.

C. Stationary Backstop: Wall-braced, single post, ceiling hung stationary basketball backboard. Model 3115, Performance Sports Systems/Gared Sports, Noblesville, IN; or approved equal.
   1. Paint all support steel PT-5.
   2. Vertical support to be 6-5/8" diameter vertical mast. Vertical mast shall be stabilized by rectangular tube side sway braces welded to the support channel and the mast.
   3. Mount goal directly through backboard and into steel flange at lower extension frame.
   4. Field verify heights and dimensions.

D. Front Retractable Backstop: Wall-braced, single post, ceilling hung front folding basketball backboard. Model 3107. Performance Sports Systems/Gared Sports, Noblesville, IN; or approved equal.
   1. Paint all support steel PT-5.
   2. Vertical support to be 6-5/8" diameter vertical mast. Vertical mast shall be stabilized by rectangular tube side sway braces welded to the support channel and the mast.
   3. Mount goal directly through backboard and into steel flange at lower extension frame.
   4. Provide electric hoist with key switch, coordinate with Electrical.
      a. PSS/Gared 1194.
         1) Motor: 3/4HP, 1PH, 110/115/120VAC 60HZ.
      b. Or approved equal.
   5. Field verify heights and dimensions.

E. Side Retractable Backstop: Side braced, single post, ceiling hung side folding basketball backboard. Performance Sports Systems/Gared Sports, Noblesville, IN; Model 3109 or approved equal.

1. Paint all support steel PT-5.
2. Vertical support to be 6-5/8” diameter vertical mast. Vertical mast shall be stabilized by rectangular tube sway braces welded to the support channel and mast.
3. Mount goal directly through backboard and into steel flange at lower extension frame.
4. Provide electric hoist with key switch, coordinate with Electrical.
    a. PSS/Gared 1194.
        1) Motor: 3/4HP, 1PH, 110/115/120VAC 60HZ.
    b. Or approved equal.
5. Field verify heights and dimension.

F. Manual Basketball Backstop Height Adjuster: Model No. 1131 Manual Adjust-A-Goal by Performance Sports System/Gared Sports, Noblesville, IN.
    1. Height adjuster shall be manufactured of steel using an Acme threaded screw rod with awning type hand crank to raise and lower backboard. Height adjuster shall be screw driven to raise and lower goal with a range of 2’-0” (6’ to 8’, 7’ to 9’ or 8’ to 10’ off of finished floor). Screw drive shall be a 3/4’’ Acme double-start threaded rod secured in two bronze bushings. Height adjuster shall be operated from floor by hand crank (included with height adjuster). Height adjuster shall be directly attached to backboard support structure.

G. Backboard, Gym: Official size 3’-6” x 6’-0” x 2 1/8” thick. Model LXP4200 by Performance Sports Systems/Gared Sports; or approved equal.
    1. Meet all NCAA and NFHSA requirements.
    2. Frame shall be welded, unitized construction fabricated from heavy wall, rectangular steel tubing. Include a vertical center strut mounted directly through the glass and into the rear frame.
    3. Glass shall be ½” thick, fully tempered (heat treated) with uniform load and impact strength. Provide official white border and target area permanently “fired-in” to front side of glass. Secure glass to unitized rear frame by L-shaped steel, perimeter frame-finished in gray powder-coat finish. Provide manufacturer’s lifetime warranty.
    4. Backboard Padding: pre-molded square corners and locking bolt-on attachment system 2” thick. Model PMCE Pro Mold Cushion Edge by Performance Sport Systems/Gared Sports; or approved equal. Minimum 5 year warranty.
        a. Color: Black.
    5. Goal: Model No. 2000+ Breakaway Goal, manufactured by Performance Sports Systems/Gared Sports, Noblesville, IN; or approved equal.
        a. Goal shall be designed to absorb shock loads and incorporate a positive lock, pressure release mechanism that is field adjustable without removing housing cover and providing 35 to 50% energy absorption. Rim shall be fabricated from 5/8” diameter, high strength, and cold drawn alloy steel, round formed to an 18” inside diameter ring. Inside of ring shall be positioned 6” from face of backboard, by heavy L-shaped, formed steel mounting whole centers for front mounting.
        b. Rim shall be provided with 12 “no tie” net attachment clips.
        c. Entire assembly shall support minimum 800 pound load on outer edge and flex under extreme dynamic loading up to 2 ¾” without permanent set or deformation.
        d. Finish shall be a durable, official orange powder coat finish.
    6. Net: Anti-Whip Pro Basketball Net, Product No. AWP by Performance Sports Systems/Gared Sports, Noblesville, IN; or approved equal.
        a. Net shall be 120 count nylon, hourglass design.

H. Backboard, Kid's Academy Gym: Official size 3’-6” x 6’-0” x 2 1/8” thick. Model AFRG42E by Performance Sports Systems/Gared Sports; or approved equal.
    1. Meet all NCAA and NFHSA requirements.
    2. Frame shall be welded, unitized construction fabricated from heavy wall, rectangular steel tubing. Include a vertical center strut mounted directly through the glass and into the rear frame.
    3. Glass shall be ½” thick, fully tempered (heat treated) with uniform load and impact strength. Provide official white border and target area permanently “fired-in” to front side of glass. Secure

glass to unitized rear frame by L-shaped steel, perimeter frame-finished in gray powder-coat finish. Provide manufacturer's lifetime warranty.

4. Backboard Padding: pre-molded square corners and locking bolt-on attachment system 2" thick. Model PMCE Pro Mold Cushion Edge by Performance Sport Systems/Gared Sports; or approved equal. Minimum 5 year warranty.
    a. Color: Black.
5. Goal: Model No. 1000 Scholastic Breakaway Goal, manufactured by Performance Sports Systems/Gared Sports, Noblesville, IN; or approved equal.
    a. Goal shall be designed to absorb shock loads and incorporate a positive lock, pressure release mechanism that is field adjustable without removing housing cover and providing 35 to 50% energy absorption. Rim shall be fabricated from 5/8" diameter, high strength, and cold drawn alloy steel, round formed to an 18" inside diameter ring. Inside of ring shall be positioned 6" from face of backboard, by heavy L-shaped, formed steel mounting whole centers for front mounting.
    b. Rim shall be provided with 12 "no tie" net attachment clips.
    c. Entire assembly shall support minimum 800 pound load on outer edge and flex under
    d. extreme dynamic loading up to 2 ¾" without permanent set or deformation.
    e. Finish shall be a durable, official orange powder coat finish.
6. Net: Anti-Whip Pro Basketball Net, Product No. AWP by Performance Sports Systems/Gared Sports, Noblesville, IN; or approved equal.
    a. Net shall be 120 count nylon, hourglass design.

I. Wall Padding:
1. Interior Wall Padding:
    a. Acceptable Manufacturers and Products:
        1) FR SAFPAD; fire retardant safety wall pads: Porter Model 345-300.
        2) AK Athletic Equipment: Flame Safe Class A Wall Pad.
        3) Or approved equal.
    b. Padding shall meet the NFPA 101; Sections 6-5.3.1.2 and 6-5.5.1.
    c. Class A rating of 0-25 flame spread and 0-450 smoke development for use on interior walls and ceilings. Laboratory tests shall be furnished to verify the pad assembly meets or exceeds ASTM E84.
    d. Pads shall be 2'-0" wide, height as indicated in drawings. Panels shall be constructed with a flame retardant, 2" thick, neoprene foam filler with a density of 5.5 lbs/ft. and an Indentation Force Deflection (IFD) of 25-45 pounds.
    e. Interior foam shall be bonded to a 7/16" OSB Entire face, including nailing margins, shall be upholstered with a 14 ounce fire retardant vinyl laminated, high tensile, polyester base fabric material. Colors shall be a specified in "Interior Finish Schedule." Any exposed backing material is to be painted Black.
    f. Cutouts shall be field made. Installer shall be responsible for proper inspection and installation.
2. Wall Pad Coverings:
    a. Acceptable Manufacturers:
        1) Value Vinyls.
        2) AK Athletic Equipment.
        3) Or approved equal.
    b. Wall Pad Types:
        1) WP-1
            (a) Basis of Design:
                (1) Manufacturer: Value Vinyls.
                (2) Collection: Champion MVP 14.
                (3) Color: Camel.
                (4) Finish: Leather.
            (b) Or approved equal.

(c) Weight: 14 oz.
(d) Size: See Drawings.
(e) Location: Kids Academy Tumbling Studio.
(f) URL: https://www.valuevinyls.com/all-fabrics/champion-mvp-14/

2) WP-6
(a) Basis of Design:
(1) Manufacturer: Value Vinyls.
(2) Collection: Champion MVP 14.
(3) Color: Forest Green.
(4) Finish: Leather.
(b) Or approved equal.
(c) Weight: 14 oz.
(d) Size: See Drawings.
(e) Location: Pickleball Gym, Basketball Gym Side Walls.
(f) URL: https://www.valuevinyls.com/all-fabrics/champion-mvp-14/

3) WP-9
(a) Basis of Design:
(1) Manufacturer: Value Vinyls.
(2) Collection: Champion MVP 14.
(3) Color: Galaxy Grey.
(4) Finish: Leather.
(b) Or approved equal.
(c) Weight: 14 oz.
(d) Size: See Drawings.
(e) Location: Basketball Gym End Walls.
(f) URL: https://www.valuevinyls.com/all-fabrics/champion-mvp-14/

4) WP-10
(a) Basis of Design:
(1) Manufacturer: Value Vinyls.
(2) Collection: Champion MVP 14.
(3) Color: Bright Navy.
(4) Finish: Leather.
(b) Or approved equal.
(c) Weight: 18 oz.
(d) Size: See Drawings
(e) Location: LTKA
(f) URL: https://www.valuevinyls.com/all-fabrics/champion-mvp-14/

3. Exterior Wall and Fence Padding:
a. Vinyl Covering: 18 oz./sq. yd. Vinyl, UV & Weather Resistant.
b. 3" Thick Polyurethane High Impact Foam.
c. 3/4" Marine Grade Plywood.
d. Steel Backup Plates and fasteners: By manufacturer to fasten to chain link fence, wall or other substrate as indicated on drawings.
1) WPX-1
(a) Manufacturer: Douglas Industries. Or approved substitution.
(b) Product: Douglas Bolt & Backup Plate Plywood Backed Field Wall Padding.
(c) Color: Gray.
(d) Size: See drawings.
(e) Finish: Standard.
(f) Location: As shown on drawings.

J. Wall Attachment Clips: Install a wall attachment system to allow removal of panels.
1. Clips shall be heavy, precision extruded aluminum (6063-T5) with attachment holes pre-drilled.

2. Z Clip Channel: No. 00347-300; 6'-0" long, for mounting either on the wall to accept the lower 1" lip or a snap-in type trim for the top lip when used with Wall Attachment Clip below. Z clip shall be pre-drilled with 13/64" diameter holes on 9" centers.
3. Wall Attachment Clips: No. 00347-100 – 6'-0" long and may field cut to required length. Provide pre-drilled 13/64" diameter holes at 9" on center.

K. Guards: Heavy duty, steel frame. Double-hinged on one side with wing-nut fastener on opposite side. Install per manufacturer's instructions. Exterior Wall Padding: Provide materials specifically made for outdoor use. Wall padding shall consist of a 2-inch foam filler laminated to an exterior treated paneling and covered with a 17.5 oz Class "A" Flame retardant vinyl laminated polyester on full surface, sides, ends and including all wood edges with the bottom vinyl edge having #3 brass grommet weep hole inserted along it.
1. Backer Board: Not less than ½" exterior treated plywood or other exterior treated paneling.
2. Foam Filler: Not less than 2-inch thick polyurethane foam filler.
3. Vinyl Covering: 17.5 oz Vinyl Laminated Polyester, Achieving NFPA 701 CSFM, and a Class "A" fire rating under ASTM E84, with a "smoke developed" index of 450 or less and a "flame spread" index of 25 or less.
    a. Exterior Vinyl Color: To be selected from manufacturers standard color chart.

L. Alpha Rack Divider Panels:
1. Metal Frame provided by owner, installed by contractor.
2. MDF Panel by millwork provider.
3. Frameless mirrors by glazing provider.
4. Coordinate work with that of sections 05 50 00, 06 40 00, 08 81 00 and with details found in Casework Book.

M. Ballet Bar: 1-1/2" diameter, unfinished oak bar with pre-drilled holes for mounting hardware – see drawings for length and quantity.
1. Ballet Bar Wall Mounted Brackets:
    a. Vita Vibe Metro or approved substitution:
    b. Fixed, wall mounted double bar brackets - Steel, see drawings for quantity and spacing.
    c. Finish: Metallic Silver
    d. Wood panel behind bracket mounting plate: clear coat, species to match floor.
2. Ballet Bar Floor Mounted Bracket:
    a. Vita Vibe Metro or approved substitution:
    b. Fixed, floor mounted double bar posts and brackets - Steel, see drawings for quantity and spacing.
    c. Finish: Metallic Silver.
    d. Wood Escutcheon plate with clear coat, species to match floor.

2.02 TUMBLING EQUIPMENT

A. Tumbling Trampoline and Landing Mat:
1. Trampoline:
    a. Supplier: Spieth America.
    b. Product: Tumbl Trak.
    c. Model #: VTL-21-20.
    d. Length: 20'
    e. Skirt: TumblTrak,VTL-SP-21, 21' Sections to extend entire length of trampoline.
2. Landing Mat:
    a. Supplier: Spieth America.
    b. Model #: 71018.
    c. Size: 7' W x 10' L

B. Training Beam:
1. Supplier: Spieth America.
2. Product: JFK Low beam.
3. Model #: 355-151/165.

4. Location: Tumbling Studio – coordinate location with Owner prior to installation.

C. Rings:
1. Supplier: Spieth America.
2. Model #: 363-JFK.
3. Location: Tumbling Studio – coordinate location with Owner prior to installation.

D. Single Bar:
1. Supplier: Spieth America.
2. Product: JFK Single Bar w/Fiberglass Rail.
3. Model #: 361-JFK.
4. Location: Tumbling Studio – coordinate location with Owner prior to installation.

E. End Block:
1. Supplier: Spieth America.
2. Product: TT End Block
3. Model #: CEB-1, Red - 71" x 22" x 20"
4. Location: Tumbling Studio – coordinate location with Owner prior to installation.

2.03 FLOORING

A. Foam Bonded Carpet (CF-1): Provide the following product and color or approved equal.
1. Manufacturer: Spieth America.
2. Product: FLEXI Foam Bonded Carpet.
3. Model #: 139RF/CHARC.
4. Color: Blue.
5. Size: As shown on Drawings.
6. Location: Tumbling Studio.
7. Accessories: Floor Velcro 4" x 42' Color to match.

2.04 TRAVERSE WALL

A. Traverse Wall:
1. Manufacturer: Everlast Climbing Industries Inc (https://everlastclimbing.com/)
2. Product: Magna Traverse Wall.
3. Surface: Magna.
4. Dimensions: See Drawings.
5. Contact: Tim Sudeith, tim.sudeith@everlastclimbing.com
6. Location: Studio - Movement.

B. Traverse Wall Mats:
1. Manufacturer: Everlast Climbing Industries Inc.
2. Product: Traverse Wall Mats.
3. Color: Gray
4. Dimensions: To match length of Climbing Wall.
5. Quantity: 1.
6. Contact: Tim Sudeith, tim.sudeith@everlastclimbing.com
7. Location: Studio - Movement.

C. Traverse Wall Accessories:
1. Safari Plank Wall with mats.
    a. Manufacturer: Everlast Climbing Industries Inc.
    b. Color: Gray.
    c. Quantity: 1.
    d. Contact: Tim Sudeith, tim.sudeith@everlastclimbing.com
    e. Location: Studio - Movement.
2. Safari Wild Web with mats:
    a. Manufacturer: Everlast Climbing Industries Inc.
    b. Color: Gray.

c. Quantity: 1
d. Contact: Tim Sudeith, tim.sudeith@everlastclimbing.com
e. Location: Studio - Movement.

3. Traverse Wall Challenge Course:
   a. Manufacturer: Everlast Climbing Industries Inc.
   b. Quantity: 1
   c. Contact: Tim Sudeith, tim.sudeith@everlastclimbing.com
   d. Location: Studio - Movement.
4. Versa Challenge Course:
   a. Manufacturer: Everlast Climbing Industries Inc.
   b. Quantity: 1.
   c. Contact: Tim Sudeith, tim.sudeith@everlastclimbing.com
   d. Location: Studio - Movement.

PART 3 EXECUTION

3.01 INSPECTION

A. Examine work on which specified work is in any way dependent to ensure conditions are satisfactory for installation. Report in writing to LTF Construction any defects which may influence completion of specified work. Absence of such notification will be construed as acceptance of work in place. Do not attempt installations until correct conditions are present or you have a written order to do so.

B. Equipment herein specified shall be installed by factory trained craftsmen skilled in their trade. They shall be responsible for accurate fit to specified work.

3.02 ERECTION

A. Coordination:
   1. Coordinate installation with LTF Construction's schedule to ensure orderly and timely progress of the total work.
   2. Placement of equipment relating to floor groove lines shall be coordinated with Work under Flooring Section.

B. Basketball Backstops:
   1. Install in accordance with manufacturer's instructions and approved shop drawings.
   2. Ensure equipment does not interfere with one another and required clearances.
   3. Contractor shall adjust backstops and backboards for plumb and level.

C. Gymnasium Divider:
   1. Install in accordance with manufacturer's instructions and approved shop drawings.

D. Alpha Rack Divider Panels:
   1. Anchor panels as specified in 05 50 00. Coordinate length of anchors with thickness of isolated slab.
   2. Attach MDF board to frame as indicated on details in Casework book.
   3. Attach mirror to MDF board as specified in 08 81 00.
   4. Coordinate sequence of installation with work of all involved trades and adjacent construction activities.

E. Ballet Bars:
   1. Install in accordance with manufacturer's instructions and approved shop drawings.
   2. Coordinate wood finishes with work of other Sections.

F. Tumbling Equipment:
   1. Install in accordance with manufacturer's instructions and approved shop drawings.
   2. Coordinate anchorage and installation sequence with other equipment and work of other Sections.

G. Adjustments: Examine installed equipment for proper anchoring and rigidity and correct as required.

3.03 CLEANING AND TOUCH-UP

A. Thoroughly clean all items of Work in this Section. Touch-up painted members, as required for proper appearance.

END OF SECTION

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SECTION 12 36 00
SOLID SURFACING COUNTERTOPS AND SILLS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Countertops for manufactured casework.

B. Interior Window Sills as indicated.

1.02 RELATED REQUIREMENTS

A. Section 01 31 00 - Project Management and Coordination.

B. Section 01 33 00 - Submittal Procedures.

C. Section 01 40 00 - Quality Requirements.

D. Section 01 60 00 - Product Requirements.

E. Section 06 10 00 - Rough Carpentry.

F. Section 06 40 00 - Architectural Woodwork.

G. Section 07 92 00 - Joint Sealants.

H. Section 09 21 17 - Gypsum Board Assemblies.Count

I. Section 09 75 00 - Interior Stone.

1.03 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.

B. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).

C. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.1; 2016, with Errata (2017).

D. ISFA 2-01 - Classification and Standards for Solid Surfacing Material; 2013.

E. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

F. PS 1 - Structural Plywood; 2023.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Specimen warranty.

C. Shop Drawings: Complete details of materials and installation ; combine with shop drawings of cabinets and casework specified in other sections.

D. Verification Samples: For each finish product specified, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.

E. Test Reports: Chemical resistance testing, showing compliance with specified requirements.

F. Certificate: Submit labels and certificates required by quality assurance and quality control programs.

G. Installer's qualification statement.

H. Installation Instructions: Manufacturer's installation instructions and recommendations.

I. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.
   3. See Sections 01 33 00 and 01 60 00.

J. Maintenance Data: Manufacturer's instructions and recommendations for maintenance and repair of countertop surfaces.

1.05 QUALITY ASSURANCE

A. Fabricator Qualifications: Natural Stone Institute (NSI) Accredited Natural Stone Fabricator; www.naturalstoneinstitute.org/#sle.

B. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience.

C. Quality Certification:
   1. Provide labels or certificates indicating that the installed work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
   2. Provide designated labels on shop drawings as required by certification program.
   3. Provide designated labels on installed products as required by certification program.
   4. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.07 FIELD CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.01 COUNTERTOPS

A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.

B. Solid Surfacing Countertops and Sills: Solid surfacing sheet or plastic resin casting over continuous substrate.
   1. Flat Sheet Thickness: 1/2 inch (12 mm), minimum.
   2. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISFA 2-01 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
      a. Manufacturers:
         1) Meganite, Inc: www.meganite.com/#sle.
            (a) Contact: Randy Houston randyhouston@meganite.com
         2) No Substitutions permitted.
      b. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
      c. NSF approved for food contact.
      d. Finish on Exposed Surfaces: Same as top surface..
      e. Colors by type:
         1) **AS-1:**
            (a) Color: Himalaya M601.
            (b) Edges: 1/8" radius eased at top exposed edge. Polished back at underside.
            (c) Ends: Extend beyond opening same distance as overhang and finish ends to match exposed edge.
            (d) Location: Window Sills.
         2) **AS-2:**
            (a) Color: Mt. Vancouver M002

(b) Edges: 1/8" eased at top exposed edge. Polished back at underside.
(c) Location: Dispensary.

3. Other Components Thickness: 1/2 inch (12 mm), minimum.
4. Back and End Splashes: Same sheet material,eased top; minimum 4 inches (102 mm) high.

2.02 MATERIALS

A. Wood-Based Components:
1. Wood fabricated from old growth timber is not permitted.

B. Plywood for Supporting Substrate: PS 1 Exterior Grade, A-C veneer grade, minimum 5-ply; minimum 3/4 inch (19 mm) thick; join lengths using metal splines.

C. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined. Color to match surface material.

D. Joint Sealant: Mildew-resistant silicone sealant, clear. See section 07 92 00.

2.03 CUTOUTS AND HOLES:

A. Under-counter Fixtures: Make cutouts for under-counter fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.
1. Provide vertical edges, slightly eased at juncture of cutout edges with top and bottom surfaces of countertop and projecting 3/16 inch (5 mm) into fixture opening.

B. Counter-Mounted Fixtures: Prepare countertops in shop for field cutting openings for counter-mounted fixtures. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.

C. Fittings: Drill countertops in shop for plumbing fittings, under-counter soap dispensers, and similar items.

2.04 ACCESSORIES

A. Fixed Top-Mounted Countertop Support Brackets:
1. See drawings and Section 05 50 00.

2.05 FABRICATION

A. Fabricate tops, sills and splashes in the largest sections practicable, with top surface of joints flush.
1. Join lengths of tops using best method recommended by manufacturer.
2. Fabricate to overhang fronts and ends of cabinets 1 inch (25 mm) except where top butts against cabinet or wall.
3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.

B. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.
1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
2. Height: 4 inches (102 mm), unless otherwise indicated.

C. Solid Surfacing: Fabricate tops and wall panels up to 144 inches (3657 mm) long in one piece; join pieces with adhesive sealant in accordance with manufacturer's recommendations and instructions.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.

3.02 INSTALLATION

A. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.

B. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Cut according to Manufacturer's recommendations. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.

C. Seal joint between back/end splashes and vertical surfaces.

3.03 CLEANING

A. Clean countertops surfaces thoroughly.

3.04 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 12 56 90
SPA FURNITURE

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Pedicure Chair.
   2. Shampoo Sinks with Chairs.
   3. Styling Chairs.
   4. Styling Cabinets.
   5. Styling Mirrors.

1.02 RELATED REQUIREMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Section 01 33 00 - Submittal Procedures.

C. Section 01 40 00 - Quality Requirements.

D. Section 01 60 00 - Product Requirements.

E. Section 01 92 00 - Facility Operation and Maintenance.

F. Section 06 10 00 - Rough Carpentry.

G. Section 06 40 00 - Architectural Woodwork.

H. Section 09 21 16 - Gypsum Board Assemblies.

I. Section 09 75 00 - Interior Stone.

J. Division 22 - Plumbing.

K. Division 23 - HVAC.

L. Division 26 - Electrical.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conference.
   1. Convene a pre-installation conference under provisions of Section 01 31 00 - Project Management and Coordination prior to commencing work of this Section.
      a. Attendance required of Contractor, system installer, and parties directly affecting work of this Section.
      b. Review conditions of installation, installation procedures and coordination required with Related Work.
      c. Coordinate Keying, compatibility and appearance of visible hardware with hardware provider.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for telescoping stands.
   1. Wiring Diagrams: For power, signal, and control wiring.
   2. Plumbing Rough-in.

B. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.
   3. See Sections 01 33 00 – Submittal Procedures and 01 60 00 – Product Requirements.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Submit O&M manuals according to the requirements of Section 01 92 00 - Facility Operation and Maintenance.
   1. Precautions for cleaning materials and methods that could be detrimental to telescoping stand finishes and performance.
   2. Methods for maintaining upholstery fabric.

1.06 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Fire-Test-Response Characteristics of Upholstered Chairs:
   1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   2. Standard: Provide Spa Furnishings to comply with NFPA 102.

C. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA - ABA Accessibility Guidelines and ICC/ANSI A117.1.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Installers shall satisfy the requirements of Section 01 60 00 in addition to the requirements below.

B. Store products in a climate controlled environment, in Manufacturer provided packaging, until ready for assembly.
   1. Do not deliver materials on site until building is enclosed and maintained at a climate recommended by Manufacturer for the materials.

C. Furniture materials damaged by improper storage or handing shall be replaced at no cost to the Owner.

PART 2 PRODUCTS

2.01 PEDICURE CHAIR

A. Continuum Vantage VE Pedicure Chair w/discharge pump & side panels.
   1. Dimensions: 62” L (158 cm) x 31” W (116 cm) x 51.5” H (131 cm). From Floor to Seat: 25” (63.5 cm)
   2. Client Weight Capacity: 350 lbs (160 kg)
   3. Basin Capacity: 4.75 US Gallons (18 liters)
   4. Power Requirements: 120V AC, 15 Amp, 60HZ. A separate and dedicated 15 Amp GFCI protected circuit MUST be used for each
   5. Construction: Welded steel frame. Architect to select from full range of color and finish options.
      a. Venting: Dual vented air system with (2) 2” diameter vents. Connect to in-wall ducting.
   6. Basin: Chemical resistant acrylic reinforced with three (3) layers of fiberglass, pre-plumbed.
   7. Jet System: One (1) standard Dual Stream No Pipe™ Jet.
   8. Plumbing:
      a. Incoming: Hot/Cold supply lines required (1/2” ID). Male connections located on back of spa.
      b. Sprayer/Filler: Inline back-flow prevention is provided.
      c. Discharge: Gravity drain or optional factory installed drain pump (air activated switch). If factory installed drain pump is utilized. Provide built-in back flow prevention.
      d. If through floor installation is desired, refer to Plumbing Rough-in Drawing (available at ContinuumFootspas.com).
   9. Massage: Echo/Vantage - Full Function Shiatsu Back Massage with fold down manicure trays and hand held control wand.
   10. Deluxe Tech Chair: Base: 24” diameter (61 cm) Height range (excluding cushion): 13” to 16” (33 cm to 41 cm)
      a. Net weight: 15 lbs (7 kg)

b. Shipping Dimensions: 26” W (66 cm) x 26” L (66 cm) x 12” H (31 cm) Shipping Weight: 23 lbs (11 kg)
c. Standard Tech Chair: Base: 21” diameter (53 cm) Height range (including cushion): 14” to 16.5” (36 cm to 42 cm)
d. Finish: Espresso / Upholstery - Chocolate.

2.02 SHAMPOO SINKS WITH CHAIRS

A. Oregon Shampoo Chair:
1. Supplier: Spa Interiors MPI.
a. Contact Chris Erickson- chris@spainteriors.com
b. Shampoo chair with flip-up.
1) Model: Oregon.
2. Coordinate installation with Plumbing and Millwork.

2.03 STYLING CHAIR

A. Atticus Styling Chair
1. Supplier: CosmoProf Beauty Supply
2. Model: AT60/H1B/S60
3. T-bar footrest with standard base.
4. Color:
a. Vinyl: Black
b. Base: Black
c. Footrest: Chrome

2.04 STYLING CABINETS

A. Single Life Time Trolley.
1. Supplier: Spa Interiors MPI.
a. Contact Chris Erickson- chris@spainteriors.com.
2. Model: LT101
3. 16"w x 18"d x 34-1/4".
4. Pulls: Versa bar style.
5. Quad Outlet, provide inside.
6. Standard Plug in Ready.
7. Chrome Tool Inserts.
8. 54” power cord on casters.
9. Stainless Steel Top.

2.05 STYLING MIRROR

A. Dual LED lighted mirror on casters.
1. Supplier: Spa Interiors MPI.
a. Contact Chris Erickson- chris@spainteriors.com.
2. Model: LT102
3. Dimensions: 38"w x 22"d x 89-1/4"h.
4. Pulls: Versa Bar style.
5. Duplex outlet with USB on side.
6. Standard Plug in Ready
7. Shelf.
8. Light:
a. Temperature: 3500K
b. Dimmer & on/off switch

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas where Spa Equipment is to be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install spa furnishing to comply with referenced safety standard and manufacturer's written instructions.

B. Pedicure chairs must be installed by a licensed electrician and a licensed plumber in accordance with all national, state and local codes / regulations.

C. Assemble furniture in proximity to their ultimate destination, such that no damage occurs due to moving assembled furniture around the construction site.

3.03 ADJUSTING AND CLEANING

A. On completion of installation, lubricate, test, and adjust each unit so that it operates according to manufacturer's written operating instructions.

B. Clean installed units exposed and semiexposed surfaces. Touch up shop-applied finishes or replace components as required to restore damaged or soiled areas.

3.04 PROTECTION

A. Protect assembled furniture from damage by ongoing construction activities.

1. Damaged furniture shall be replaced at no cost to the Owner.

END OF SECTION

SECTION 12 92 00
ARTIFICIAL PLANTS / GREEN WALLS

PART 1 GENERAL

1.01 SUMMARY

A. Provide artificial green walls as indicated on Drawings.
   1. Interior Artificial Green Walls.
   2. Exterior Artificial Green Walls.

1.02 RELATED SECTIONS

A. Section 01 33 00 - Submittal Procedures.

B. Section 01 40 00 - Quality Requirements.

C. Section 01 60 00 - Product Requirements.

D. Section 09 21 16 - Gypsum Board: Wall Substrates.

E. Section 10 14 00 - Signage.

1.03 REFERENCE STANDARDS

A. ASTM E84 "Standard Test Method for Surface Burning Characteristics of Building Materials."

1.04 SUBMITTALS

A. Submit manufacturer’s product data and installation instructions for each type of green wall, with mounting hardware, adhesive and accessories required.
   1. Include data on physical properties, fire hazard classification and fire detection characteristics of wallcoverings.

B. Shop Drawings: Submit shop drawings of green wall, including attachment and coordination with signage, other adjacent features.

C. Submit 6” x 9” samples of each type of green wall specified, inclusive of product name and accessories labeled on the back of each sample.

D. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.
   3. See Sections 01 33 00 and 01 60 00.

E. Submit a copy of maintenance instructions to Owner in accordance with Division 1, Section "Contract Closeout."

1.05 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Manufacturer: Provide each type of green wall required produced by one manufacturer whose published literature clearly indicated compliance of product with specified requirements.

C. Applicator: Installation by skilled applicators certified by Manufacturer to install their product.

D. Fire Hazard Classification: Provide materials that comply with Class A Fire Rating when tested in accordance with ASTM E84.
   1. Flame Spread: 10.
   2. Smoke Developed: 25.

E. Field Test Panels: Install not less than three (3) full-width sheets of each pattern specified in an area designated by the architect and or designer. Review installation area for conformance to manufacture’s standard installation instructions. Maintain approved test area as part of the finished installation work and as a standard of comparison for the installation throughout the project.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver all wallcovering to the job site in the distributor's undamaged packaging clearly labeled and properly identified.

B. Store materials in a clean, dry, protected area where temperature and humidity remain stable and within the ranges specified by the distributor.

1.07 PROJECT CONDITIONS

A. Maintain a constant temperature range of 65 degrees F to 85 degrees F, with not more than 50% relative humidity and not less than the relative humidity specified for the project area in the AWI Quality Standards Section 1700-T-19, for at least 4 days prior to, throughout the installation period and maintained consistently thereafter.

B. Surface preparation: Provide hanging surface that is smooth and free of all excess dust, oils or other foreign matter.

C. Provide the following conditions, according to type of substrate:
   1. Provide Gypsum board finish in compliance AWCI Specification, Level 4.
   2. Finish plaster walls to the manufacturer’s specification and free from undulations and surface defects.

1.08 WARRANTY

A. Submit manufacturer's 1 year written warranty against defects in material and workmanship.

PART 2 PRODUCTS

2.01 MATERIALS: GREEN WALLS

A. Artificial green wall V-2:
   1. Manufacturer and Product: Geranium Street USA; 50/50 blend of Ficus Hedge Mat and Medium Green Boxwood Mat.
   2. Color: Varied Green.
   3. Material UV Stabilized polyethylene, backing materials and installation materials.
   4. Sizes: Custom to locations as identified on plans and details.
   5. Contact: Alex Tamowski, 760-978-7335, alex@geraniumstreet.com

B. Artificial green wall V-3:
   1. Nature's Creation Lush Trimmed Boxwood Mat, 3.5" inch height.
   2. Color: Tutone Green.
   3. Material: UV stabilized polyethylene, backing materials and installation materials.
   4. Sizes: 10' x 10'
   5. Contact: Shaun Lewis, 248-515-7184, shaun@naturescreation.com

C. Artificial green wall V-4:
   1. Manufacturer and Product: Nature's Creation: Preserved Moss Wall.
   2. Color and Texture: By Manufacturer as typical for Life time.
   3. Material: Preserved natural plant materials, with Clear Walnut framing by Manufacturer.
   4. Size: Custom, see drawings.
   5. Location: Spa DBE, see drawings.
   6. Contact: Shaun Lewis, 248-515-7184, shaun@naturescreation.com

D. Artificial green wall V-6:
   1. Manufacturer and Product: Vistafolia; Luxury Flowering Boxwood
   2. Color: Variegated boxwood
   3. Material UV Stabilized polyethylene, backing materials and installation materials.
   4. Sizes: Custom to locations as identified on plans and details.
   5. Contact: Shaun Lewis, 248-515-7184, shaun@naturescreation.com

2.02 ACCESSORIES

A. Manufacturer's recommended anchors and adhesives.

B. Exterior applications:
   1. Provide Neoprene washers (or manufacturer recommended equivalent) at all penetrations into building wall.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates and installation conditions.

B. Test substrates with suitable moisture meter. Verify that moisture content does not exceed 4%.

C. Verify that substrate surfaces are clean, dry, smooth, structurally sound and free from surface defects and imperfections that would show through the finished surface.

D. Notify the contractor and architect in writing of any conditions detrimental to the proper and timely completion of the installation.

E. Do not proceed with work until conditions have been corrected.

3.02 PREPARATION

A. Follow Manufacturer's instructions for installation, unpacking and unfolding the foliage.

B. Coordinate with Signage provider and details.

3.03 INSTALLATION

A. Install green walls in accordance with manufacturer’s written installation instructions.

B. Provide recommended anchors.
   1. See details for exterior installations.

C. Install with recommended air space.

D. Install such that similar panels are not adjacent to each other.

E. Install accessory materials randomly, but evenly, around the panels as recommended by manufacturer.

F. Install each sheet in sequential, numerical order, as indicated in Manufacturer's instructions.

3.04 CLEAN-UP COMPLETION

A. Upon completion of the work, remove excess materials, debris and rubbish resulting from the installation and leave the area in a clean and orderly condition.

B. Protect the finished green walls from damage that may occur from other trades until project has been completed.

END OF SECTION

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SECTION 13 08 00
COMMISSIONING OF SPECIAL CONSTRUCTION

PART 1 GENERAL

1.01 SUMMARY

A. This section includes specific requirements that apply to the implementation of the Commissioning Process and this Division Contractors' participation in this process. This section details the project specific equipment and systems that are included in the Commissioning Process. For general descriptions and responsibilities, refer to SECTION 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

1.02 RELATED DOCUMENTS

A. The Owner's Project Requirements (OPR) document.

B. The Basis of Design (BoD) document.

C. The Project Commissioning Plan (CxP) document.

D. ASHRAE Standard 202-2013 - Commissioning Process for Buildings and Systems.

E. LEED v4 for Building Design and Construction.

1.03 RELATED SECTIONS

A. SECTION 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS

B. SECTION 07 08 00 - COMMISSIONING OF THERMAL AND MOISTURE PROTECTION

C. SECTION 08 08 00 - COMMISSIONING OF OPENINGS

D. SECTION 11 08 00 - COMMISSIONING OF EQUIPMENT

E. SECTION 14 08 00 - COMMISSIONING OF CONVEYING SYSTEMS

F. SECTION 21 08 00 - COMMISSIONING OF FIRE SUPPRESSION SYSTEMS

G. SECTION 22 08 00 - COMMISSIONING OF PLUMBING SYSTEMS

H. SECTION 23 08 00 - COMMISSIONING OF MECHANICAL SYSTEMS

1.04 DEFINITIONS

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

1.05 RESPONSIBILITIES

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

PART 2 PRODUCTS

2.01 NO PRODUCTS SUPPLIED

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

B. Contractors and/or Vendors shall provide the specialty testing equipment necessary to fulfill the functional testing requirements, for the duration of the testing period.

PART 3 EXECUTION

3.01 GENERAL

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.02 MEETINGS

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.03 **SYSTEM START-UP**

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.04 **PRE-FUNCTIONAL CHECKLISTS**

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.05 **FUNCTIONAL PERFORMANCE TESTING**

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.06 **TRAINING**

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.07 **SYSTEMS TO BE COMMISSIONED**

A. GENERAL
   1. Commissioning specifications supplement the requirements of individual specifications sections but shall not be interpreted to replace or diminish the specified scope of any individual section.
   2. For all systems listed below, Division Contractor shall comply with all commissioning requirements specified.

B. APPLICABLE SYSTEMS
   1. Swimming Pools
   2. Swimming Pool Finishes
   3. Swimming Pool Piping & Valves
   4. Swimming Pool Equipment and Accessories
   5. Waterslides

END OF SECTION

SECTION 13 11 13

BELOW GRADE SWIMMING POOLS

PART 1 GENERAL

1.01 SUMMARY

A. This section includes work requirements required for the construction of pools with all associated equipment and appurtenances.

B. Related Documents

1. Division 1, GENERAL REQUIREMENTS.
    a. All applicable requirements of Division 1 shall apply and are incorporated into this section by reference. In the event of a conflict, the information contained in Division 1 shall prevail.
2. Section 13 11 14 “Swimming Pool Structure – Cast-In-Place Concrete”.
3. Section 13 11 14.5 “Shotcrete for Pools”.
4. Section 13 11 15 “Swimming Pool Finishes”.
5. Section 13 11 16 “Swimming Pool Piping and Valves”.
6. Section 13 11 46 “Swimming Pool Equipment and Accessories”.
7. Section 13 14 13 “Water Slides”
8. Section 07 84 00 “Firestopping”.

C. Reference Standards

1. The work in the sections of Division 13 is subject to the requirements of applicable portions of the following standards:
    a. National Sanitation Foundation (NSF) International Standard 50 – Circulation System Components and Related Materials for Swimming Pools, Spas/Hot Tubs.
    b. Hydraulic Institute Standards.
    c. IEEE Standards.
    d. NEMA Standards.
    e. NEC Standards.
    f. Underwriters Laboratories (UL).
    g. National Fire Protection Association (NFPA) 70 – National Electric Code.
    h. Utah Code R392-302: Design, Construction, and Operation of Public Pools (Current Revision)
    i. b. Salt Lake Valley Health Department Health Regulation #2: Design, Construction, and Operation of Pools Regulation (Current Revision)
    j. Virginia Graeme Baker Swimming Pool and Safety Act (VGBA ANSI/APSP/ICC-16 2017).
    k. ADA Standards for Accessible Design 2010.
    l. OSHA Rules and Regulations.

D. Definitions:

1. Pool: The term “pool” or “swimming pool” as used within the sections of Division 13 shall reference all types of aquatic water bodies utilized for recreational swimming, competitive swimming, and therapy and includes swimming pools, spas, wading pools, and splash pads.

E. Qualifications of Pool Contractor (No Exceptions)

1. The Pool Contractor must have had at least ten (10) years’ experience in the construction of the types of swimming pools herein specified and must list at least five (5) pools of these types. Each pool with a water surface area of not less than these pools, which have been constructed and which, upon investigation, would be found to be completed in a satisfactory manner, in operation at least five (5) years, and incorporate concrete structure, perimeter gutter system, pressure sand filters, and automated chemical controllers.

2. The Pool Contractor shall furnish complete evidence that they have the facilities, equipment, personnel, etc. to complete all phases of this trade division. Prior approval must be obtained before entering into any subcontract for this work. An AIA-A305 Contractors Qualifications Statement shall be submitted with request for approval.

F. Scope of Work

1. The Pool Contractor shall furnish all materials, equipment, and labor required for the complete construction of fully operational pools as detailed within the Drawings and described within these Specifications. It is the Pool Contractor’s responsibility to ensure that the pool is constructed in compliance with all referenced standards.

2. Equipment manufacturers and model numbers identified on the drawings and equipment lists are the basis of design. Alternate manufacturers may be considered. The pool contractor is solely responsible for all design coordination or changes required by other trades to accommodate requested alternate equipment.

3. Work Included (furnish all labor, materials, and equipment as required):

   a. Layout of all pools (with General Contractor, as shown within Drawings).

   b. Furnishing and subsequent removal of all equipment, tools, scaffolding, rigging, hoisting, etc. as required for construction of the pools and the installation of any equipment, appurtenances, or accessories.

   c. Excavation as required for all pools. Excavation shall be completed in accordance with the requirements indicated within this Specification, the Drawings, and the geotechnical report and recommendations.

   d. Compaction of the excavated pool subgrade and/or additional subgrade stabilization measures required or recommended within the geotechnical report. The pool subgrade shall be in full compliance with the geotechnical recommendations prior to placement of base material.

   e. Furnish and install pool base material as indicated within the Drawings.

   f. Furnish and install drain tile, aggregate materials, and fabric as indicated within the Drawings and geotechnical report.

      1) Exterior: Connect to and furnish site well. Plumbing Contractor to connect site well to appropriate facilities (install appropriate hub for connection).

      2) Interior: Connect to building drain tile sump/stubs furnished by Plumbing Contractor as indicated within the Drawings.

g. Trench excavation and backfill for all pool piping in accordance with the geotechnical report.

h. Furnish and install pool piping, valves, and process fittings as required for complete operating pool systems as indicated within the Drawings.

1) Furnish and install all piping, equipment, supports, and anchors as necessary and as required by manufacturer's recommendations.

2) Furnish and install Link-Seals at all piping penetrations in foundation walls, interior building walls and surge tanks (for piping penetrations that are not pre-established and will not be installed prior to concrete wall construction). Pool Contractor shall be on site during forming and placement of reinforcing for any interior building or surge tank walls that require pipe penetrations (to coordinate location with Concrete Contractor). Pool Contractor shall furnish all necessary sleeves for installation by Concrete Contractor and shall furnish and install piping seals within sleeves (or concrete if sleeves are removed) following installation of piping.

3) Pressure test all completed piping systems in accordance with the requirements of this section.

4) Furnish and install valve tags and pipe identification labels indicating system and direction of flow. Install labels on all lengths of pipe between fittings and every ten linear feet (10') on pipe runs longer than fifteen linear feet (15').

5) Furnish and install fire seals at pipe penetrations in all fire-rated assemblies in accordance with Section 13 11 16.

6) Furnish and install pipe insulation within all plenum spaces in accordance with Section 13 11 16.

7) Furnish and install pipe insulation on all cold spa piping that is not buried in accordance with Section 13 11 16.

8) Furnish and install pipe insulation on all pool fill piping as indicated in the Drawings in accordance with Section 13 11 16. *(include if: over finished space)*

i. Structural design and construction of cast-in-place concrete pool structures (design-build) including all required formwork, steel reinforcing, and accessories.

j. Structural design and construction of cast-in-place concrete surge tank (design-build) for Outdoor Pools, including all formwork, steel reinforcing, and accessories as indicated within the Drawings. (Indoor Pool surge tanks constructed by Concrete Contractor.)

1) Design loading to include:

(a) Soil pressure on tank lid and walls based on depth of soil noted in aquatics drawings.

(b) Confirm whether backfill material used around surge tank is "select" or "native", and use corresponding at-rest pressure noted in the geotechnical report.

(c) Seismic thrust load from soil as noted in the geotechnical report.

(d) 200 psf overburden live load above tank lid.

(e) 100 psf live load surcharge on soil surrounding surge tank for wall design.

k. Cast-in-place concrete construction is the basis of design. Shotcrete construction may be allowed based on minimum Contractor qualifications noted in these Specifications.

l. Coordinate electrical bonding of the pool structure, accessories, deck equipment, etc. with the Electrical Contractor.

m. Verify that all required electrical, plumbing, health, or building inspections have been completed prior to placing concrete.

n. Furnish and install backwash pit grating.

o. Backwash pit finishes.

p. Placement and compaction of free-draining granular backfill around pools (to subgrade elevations required for adjacent work) in accordance with geotechnical report.

q. Perform test for water tightness on all concrete vessels, as indicated within this Section.

r. Furnish and install all process equipment and accessories as indicated within the Drawings and Section 13 11 46, and as necessary to construct fully operating pool systems.

1) Pumps: Furnish and install pumps including base plate and concrete equipment pad. Electrical power supply connections by Electrical Contractor.

2) Variable Frequency Drives (VFD's): Furnish and install variable frequency drives including any wall mounting hardware or unistrut support. Electrical power supply by Electrical Contractor. Low voltage control wiring to pump by Pool Contractor.

3) Strainers: Furnish and install strainers including concrete equipment pad.

4) Filters: Furnish and install all filters, face piping, filter equipment (including media), and concrete equipment pad if required or recommended by manufacturer. Furnish and install any additional piping, valves, etc. necessary for a complete filtration and backwash system.

5) UV: Furnish and install ultraviolet disinfection system and concrete equipment pad (if required or recommended by manufacturer). Furnish and install electrical connections between UV unit and control panel. Electrical power supply to control panel by Electrical Contractor.

6) Heat Exchanger: Furnish and install all pool connections to heat exchanger as indicated within the Drawings. Furnish and install thermowells, Y-strainers, pressure gauges, and flow sensor within pool side piping for heat exchanger operation.

7) Pool Heaters: Furnish and install gas-fired heaters. Furnish and install pool connections as indicated within the Drawings.

8) Furnish and install make-up water connection.

9) Furnish and install fittings to receive thermowells and flow sensors in pool piping for mechanical equipment as indicated within the drawings and equipment lists.

10) Chemical Controller: Furnish and install chemical controller, flow cell, sample stream piping, low voltage wiring connections, etc. Electrical power

supply, line voltage connections and chemical feed power relays (if required) by Electrical Contractor.

11) Chemical Feed Pumps: Furnish and install chemical feed pumps, injectors, and tubing. Furnish and install bulk chemical tanks including all required piping connections (quick connect fill piping, connection to venting, level monitor, etc.).

12) pH Control System: Furnish and install complete sodium bisulfate feed system as indicated on the drawings.

13) CO_2 System: Furnish and install CO_2 feeder, diffuser, and all tubing from CO_2 regulators to feeders and subsequent diffusers. CO_2 tanks and regulators by General Contractor's chemical supply vendor. Pool Contractor shall furnish conduit (including building penetrations) from feeders to tank location. Coordinate final installation of tubing connection to regulators with General Contractor's chemical supply vendor.

14) Flow Meters: Furnish and install flow sensors and flow monitors as indicated on the drawings. Low voltage wiring connections from sensor to monitor and chemical controller by Pool Contractor.

15) Water Level Controller: Furnish and install water level controller and applicable solenoid/isolation valves and piping. Low voltage solenoid valve and level sensor relay wiring to water level controller by Pool Contractor.

s. Furnish and install all underwater pool lighting.

1) Furnish light niche and lights.

2) Install light niche and watertight conduit to a distance 5' past exterior face of pool or vessel wall.

3) Electrical Contractor shall furnish remaining conduit and all electrical connections.

4) Following completion of electrical connections, Pool Contractor shall install lights and face rings.

t. Furnish and install all pool interior plaster and tile finishes.

1) Pools and Spas: Pool Contractor is responsible for all tile within pools and spas, up to and including handhold tile (at top of interior finished wall face). All other surrounding tile beyond pool and spa handhold is by Tile Contractor (top of raised wall, outside face of raised wall, surround, etc.).

u. Furnish and install pool coping.

v. Furnish and install gutter systems, including all necessary formwork, gutter grating systems, brackets, fasteners, etc.

1) Completely clean entire gutter and pool of formwork immediately following form removal.

2) Finish interior gutter surface with cement-based waterproof coating.

w. Depth and marking tiles.

1) Furnish and install all required depth and marking tile on pool walls.

2) Furnish all required depth and marking tile required for adjacent deck surface and building walls. Depth and marking tiles on adjacent deck surfaces and building walls to be installed by applicable deck finish surface contractor.

Coordinate and approve depth and marker tile placement with applicable contractor prior to final installation.

3) Pool Contractor is responsible for ensuring that all depth and marking tile are installed in conformance with applicable requirements and local codes.

x. Surge tank accessories and finishes.

1) Furnish and install all accessories as indicated within the Drawings (hatch, manhole steps, etc.) for both the exterior and the interior surge tanks.

2) Finish surge tank interior surfaces (walls, floors, ceiling, hatch curb riser) with cement-based waterproof coating (exterior and interior surge tanks).

y. Deck accessories.

1) Furnish, layout, and install all required deck accessories and anchors.

2) Coordinate installation of anchors within adjacent deck with Concrete Contractor. Pool Contractor shall approve anchor placement locations prior to final deck installation.

3) Install and adjust all required deck accessories following completion of the pool deck.

z. Furnish and install trench drains.

1) Coordinate installation of domestic plumbing connections for trench drains with Plumbing Contractor.

aa. Furnish and install all hydrotherapy jet and play feature equipment and accessories as indicated within the Drawings and Section 13 11 46, and as necessary to construct fully operating hydrotherapy and play feature systems.

1) Pumps: Furnish and install pumps including base plate and concrete equipment pad. Electrical power supply connections by Electrical Contractor.

2) Variable Frequency Drives (VFD's): Furnish and install variable frequency drives including any wall mounting hardware or unistrut support. Electrical power supply by Electrical Contractor. VFD's on feature pumps to be manually controlled (no flow sensor or control connections). Low voltage control wiring to pump by Pool Contractor.

3) Strainers: Furnish and install strainers including concrete equipment pad.

4) Flow Meters: Furnish and install flow meters as indicated on the drawings.

bb. Furnish and install all waterslide equipment and accessories as indicated within the Drawings, Section 13 11 46, 13 14 13, and as necessary to construct fully operating waterslide systems.

1) Pumps: Furnish and install pumps including base plate and concrete equipment pad. Electrical power supply connections by Electrical Contractor.

2) Variable Frequency Drives (VFD's): Furnish and install variable frequency drives including any wall mounting hardware or unistrut support. Electrical power supply by Electrical Contractor. VFD's on waterslide pumps to be manually controlled (no flow sensor or control connections). Low voltage control wiring to pump by Pool Contractor.

3) Strainers: Furnish and install strainers including concrete equipment pad.

4) Waterslide Flow Meters: Furnish and install flow sensors for waterslides. Low voltage wiring connections from sensor to chemical controller by Pool Contractor.

5) General Contractor shall furnish and make arrangements for the installation of the waterslides and towers. Pool Contractor shall furnish and install the waterslide water supply system and piping connections to the slides.

cc. Furnish and install all safety, maintenance, and cleaning equipment as indicated within the Drawings and equipment lists.

dd. Start-up, test, and calibrate all equipment and accessories. Fill, heat, and balance pool chemicals in accordance with local jurisdictional requirements (water, heat, electricity supplied by General Contractor, chemicals supplied by Pool Contractor).

ee. When pool is turned over to Owner it shall be fully operating and in compliance with all applicable codes, regulations, etc.

ff. Protect all work, finishes, materials, equipment, etc. from damage until final acceptance by Owner. Deliver all work to the Owner clean and in working condition.

gg. Furnish all closeout documentation as required by this Section.

hh. Conduct Owner training sessions as indicated within this Section.

ii. Obtain final acceptance by all jurisdictional authorities in a timely manner preventing delays.

jj. Conduct pool system winterization and training following the first outdoor season.

kk. Conduct pool system spring startup and training prior to the second outdoor season.

ll. Miscellaneous:

1) Furnish, install and maintain proper shoring and bracing for existing utilities, sewers, and building foundations.

2) Provide all pumping/dewatering necessary to keep excavations free from water. This shall be limited to typical dewatering needs that can be accommodated through the use of a rock sump pit and standard pump within the excavation. If sand point dewatering or other extensive methods are required, this work will be coordinated with the General Contractor. Dewatering shall be performed in accordance with the Civil Drawings, including appropriate erosion control measures.

3) Furnish, erect, and maintain all necessary barricades and signs relating to their work as required to comply with applicable safety regulations.

4. Work by Others

a. Construction of Indoor Pool surge tanks.

b. Construction of backwash pit.

c. Furnish and install interior drain tile sump pits and lift pumps.

d. Installation of sleeves through foundation walls, interior building walls and surge tank walls. Sleeves supplied by Pool Contractor, installed by Concrete Contractor. Pool Contractor to coordinate installation locations.

e. Furnish and install waterslide foundations, columns, supports, flumes, tower, and stairs.

f. Installation of adjacent concrete and paver decks.

g. Installation of depth and marker tile on adjacent pool decks and building walls. Pool Contractor to coordinate location/installation with deck finish installer.

h. Install potable water supply and RPZ type backflow preventer.

i. Domestic plumbing connections to trench drains installed by Plumbing Contractor.

j. Vent piping at chemical feed equipment and bulk chemical storage tanks.

k. Underwater lighting electrical connections and conduit from connection point provided by Pool Contractor.

l. Line voltage (120V) conduit and electrical connections to all equipment.

m. Electrical conduit from water level sensors to the relays.

n. Furnish and install heat exchanger.

o. Pool Heaters: Plumbing and Mechanical Contractors to furnish and install relief valve piping, condensate piping, vent ducting, and gas connections. Electrical power supply connections by Electrical Contractor.

p. General Contractor's selected chemical vendor shall furnish and install CO_2 tanks and regulators if included. Pool Contractor shall furnish and install conduit and tubing from feeders to CO_2 tank location (including building penetrations).

q. Electrical bonding of pool structure, adjacent deck, equipment accessories, etc.

r. Finished tile surfaces outside of interior pool surface (deck, surrounds, etc.).

s. Pool signage in accordance with local jurisdictional requirements.

5. Permits and Fees

a. All required permits and fees are to be paid by the General Contractor and approvals will be coordinated with the General Contractor, Owner, Engineer, and Pool Contractor. Pool Contractor shall assist in the permit approval process as requested and/or required by the General Contractor, Owner, Architect, or Engineer. Pool Contractor shall supply all requested submittals and additional information requested by the permitting authority.

b. The Pool Contractor shall arrange for inspections as required and obtain required certificates of inspections. Coordinate all inspection dates and times with the General Contractor.

1.02 COORDINATION AND CLARIFICATION

A. Coordinate work with all other trades.

B. Notify the Engineer immediately of any discrepancies, ambiguities in, or omissions within the Drawings or Specifications.

1. In the case of a discrepancy, the option that is more beneficial to the Owner shall be utilized.

1.03 REQUIRED SUBMITTALS

A. Product and Manufacturer Drawings and Specifications

1. Shop drawings for all equipment in accordance with Division 1 – General Requirements.
    a. Shop drawing submittals shall include, but not be limited to the following:
        1) Structural design of all pool vessels, signed and sealed by a Professional Engineer licensed in the state of UTAH.
        2) Concrete mix design, admixtures, etc.
        3) Reinforcing.
        4) Waterstops.
        5) Pool finishes (see 13 11 15).
        6) Caulking (see 13 11 15).
        7) Piping, valves, pipe sleeves, and Link Seals (see 13 11 16).
        8) All equipment as indicated within Equipment Lists for each pool (see 13 11 46).

B. Test Reports
    1. Sample of the forms intended for use.
        a. Pipe pressure test report form.
        b. Water tightness test report form.
        c. Daily water chemistry log form.
    2. Pipe pressure test reports utilizing accepted standard form.
    3. Water tightness test reports utilizing accepted standard form.
    4. Daily water chemistry logs utilizing accepted standard form. Logs shall be recorded from pool fill until turnover of operations to the Owner.

1.04 DIMENSIONAL CONFLICTS

A. All measurements shall be field verified. If any discrepancies exist between actual field measurements and measurements indicated within the drawings, the Engineer shall be informed immediately through the General Contractor. Any alteration of the plan described on the drawings due to a different field location shall be done in consultation with the General Contractor, Owner, and Engineer.

1.05 TESTS

A. Coordinate and perform all tests as required by this Specification, the Drawings, and the geotechnical report.

B. Provide all test reports to the Engineer for review and approval.

C. Testing required includes:
    1. Pool piping pressure test.
        a. All piping shall prove absolutely tight under required tests. Test all completed pool piping prior to backfill.
    2. Vessel water tightness test:
        a. All pools, gutters, and surge tanks shall be tested for water tightness prior to the application of finish materials.
    3. Soils and material testing:

a. Soils and material testing shall be performed by the Owner's representative and paid for by the General Contractor.

1) Any retesting required as the result of a failed test or questionable workmanship by the Pool Contractor shall be performed by the Owner's representative at the direct expense of the Pool Contractor.

b. The Pool Contractor is responsible for coordinating all testing schedules directly with the Owner's representative and informing the General Contractor of the scheduled tests.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original, unopened containers and packaging with all labels intact and legible.

B. Deliver materials in sufficient time and quantity to allow continuity of work and compliance with approved construction schedule.

C. Handle all materials in a manner to prevent damage.

D. Store all materials on clean raised platforms (with weather protective covering when stored outdoors). Provide continuous protection of materials against damage or deterioration.

E. Remove damaged materials from site.

F. Maintain storage of materials in a neat and orderly manner and store materials at locations designated by the General Contractor and in locations that will allow work by other trades to be performed without relocation of materials.

G. Provide for the storage of equipment and materials in excess of those allowed on site by the Owner's representative.

H. Pool Contractor is responsible for delivery, storage, handling, and protection of all equipment and materials until final acceptance by the Owner.

1.07 CLOSEOUT SUBMITTALS

A. Wall Charts

B. Record Drawings

C. Operation and Maintenance Manual

D. Warranty Documentation

E. Documentation of Owner Training

1.08 WALL CHARTS

A. A legible, laminated, wall-mounted color-coded piping flow diagram for all systems shall be provided in the equipment room.

B. A legible, laminated pump curve shall be provided for each pump, including the design point of the system, posted next to the specific pump.

1.09 RECORD DRAWINGS

A. Provide a complete set of record drawings for the included scope of work.

1. Record drawings shall include accurate illustrations, notations, and dimensions identifying as-built installation of piping, fixtures, equipment, etc.

a. Minimum information shall include.

1) Location
2) Lengths
3) Sizes
4) Inverts
5) Slopes (% and direction)
6) All other pertinent information.

2. Indicate any differences from original plans.
3. Pool Contractor shall keep their record drawings updated daily and available for review by the General Contractor, Owner, or Engineer.
4. Underground piping record drawings shall be promptly provided to the General Contractor upon completion of all underground piping for use as a reference and coordination with the work of other trades.
5. Submit one electronic copy of record drawings in PDF, AutoCAD, or Revit format for review and approval by the General Contractor, Owner, and Engineer.
6. Provide any additional information requested during the review and perform revisions, changes, and updates to the record drawings as required.
7. Submit a complete set of final record drawings electronically in digital format utilizing AutoCAD and PDF format for records.

1.10 OPERATIONS AND MAINTENANCE MANUAL

A. Prepare detailed operations and maintenance manuals for all pool systems, equipment, and finishes.

1. The operation and maintenance manuals shall be in addition to any instructions or parts lists provided by the equipment manufacturer.
2. Operation and maintenance manuals shall include the following:
   a. For each piece of equipment:
      1) Equipment function, normal operating characteristics, and limiting conditions.
      2) Assembly, installation, alignment, adjustment, and checking instructions.
      3) Lubrication and maintenance instructions.
      4) Parts list with estimated life time of parts subject to wear.
      5) Product representatives contact name and numbers.
      6) Equipment warranty information.
   b. Valve legend table identifying valve settings for normal pool operation, backwash, and drain down operating modes.
   c. A copy of the color-coded piping flow diagram wall chart for all systems.
   d. A copy of the pump curve for each pump, including the design point of the system.
   e. Operating instructions for typical pool operation modes. Operating modes shall be specifically described in outline format and in detail, referencing valve identifiers and tags. Include specific written instructions for the following operating modes and procedures.

1) Emptying and refilling the pools, including dewatering requirements during the period that the pool will be empty.

2) Filter operation and backwashing.

3) Water level control adjustment.

4) Operation, adjustment, and maintenance of chemical controllers.

5) Winterization.

6) Pool fill and startup.

7) Troubleshooting guide.

f. As-built drawings.

g. Manuals and other data shall be printed on heavy, first quality paper, 8 ½"x11" size with standard 3-hole punching. Drawings and diagrams shall be reduced to 8 ½"x11" or 11"x17". Where reduction is not practical, larger drawings shall be folded separately and placed in envelopes bound into the manuals. Each envelope should bear suitable identification on the outside.

h. Submit one electronic copy of operations and maintenance manual in PDF format for review and approval by the General Contractor, Owner, and Engineer 4 weeks prior to final jurisdictional health inspection.

i. Provide any additional information requested during the review and perform revisions, changes, and updates to the manual(s) as required.

j. Following final approval, six (6) bound volumes of each manual shall be provided. All parts lists and information shall be assembled in substantial manuals and permanent, three-ring or three-post binders. Material shall be assembled and bound in the same order as specified, and each volume shall have a table of contents and suitable index tabs.

k. Submit a complete manual electronically in PDF format.

l. All material shall be marked with Project identification and inapplicable information shall be marked out or deleted.

m. Final operations and maintenance manuals in both written and electronic format must be received prior to final jurisdictional health inspection.

1.11 WARRANTY

A. Provide the following warranties on all work.

1. The Pool Contractor shall warranty to the Owner that all materials and equipment furnished are of good quality and new unless otherwise required or permitted by the Contract Documents.

2. The Pool Contractor shall warranty that all work, materials, and equipment will be free from defects for a period of one (1) year from the date of final acceptance by the Owner.

3. The Pool contractor shall further warranty defects in design, material, or craftsmanship relating to the water tightness of the pool vessel for a period of two (2) years from the date of final acceptance.

4. The Pool contractor shall further warranty defects in material or craftsmanship of the pool underground piping systems for a period of two (2) years.

5. The Pool contractor shall further warranty tile, grout, adhesive, and exposed aggregate pool finish for a period of (5) years in accordance with manufacturer's warranties.
6. Provide the following additional manufacturer warranties.
    a. Filter tanks shall carry a fifteen (15) year non-pro-rated warranty.
        1) Internal piping shall carry a five (5) year non-pro-rated warranty.
        2) External face piping and valves shall carry a three (3) year non-pro-rated warranty.
    b. FRP Strainers shall carry a five (5) year warranty on the FRP shell.
    c. Any other equipment, accessories, and appurtenances that carry manufacturer warranties in excess of the required warranties provided by the Pool Contractor shall be appropriately registered by the Pool Contractor. The Pool Contractor shall supply all supplemental warranty information with their base warranty certification for the Owner's records and reference prior to final project acceptance.
7. The Pool Contractor shall agree to repair or replace any Work at no cost to the Owner upon written notification from the Owner of any defects, etc. within the warranty period.
8. A written warranty from the Pool Contractor, signed by an Officer of the company shall be provided to the General Contractor, Owner, and Engineer for review and approval prior to final project acceptance.

1.12 OWNER TRAINING

A. Provide training to the Owner's staff in the operations, maintenance, cleaning, winterization, and spring startup of the complete pool systems.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.01 EXAMINATION

A. Field verify conditions prior to start of work and notify General Contractor of any discrepancies between encountered conditions and those indicated within the Drawings and herein.

3.02 PREPARATION

A. Protect all adjacent surfaces, equipment, etc. to remain from damage during the course of work. Restore any damaged areas or equipment.

3.03 TESTING

A. Pool piping pressure test.
    1. Piping shall be pressurized with water to a minimum 35 psi for one full hour without any significant decrease in pressure.
        a. Upon test setup and initial pressurization, the Contractor shall obtain certification of the initial test conditions from the General Contractor or Owner's representative.
        b. Following completion of the required testing period, the Contractor shall obtain certification of the final test conditions from the General Contractor or Owner's representative.
        c. If the pressure test fails, the Pool Contractor shall locate the failure, make the proper repairs, and retest the full pipe section at their expense.

d. A successful pressure test does not release the Pool Contractor from his warranty responsibilities and guarantees.

2. Following completion and approval of initial pressure test, the piping shall be maintained under pressure while other trades continue their work in piping areas and until the finished surface has been completed or the schedule dictates final piping connections to pumps, etc. The pressure shall be inspected and recorded weekly.

B. Vessel water tightness test.

1. Water tightness testing shall be in accordance with ACI 350.1-01, “Tightness Testing of Environmental Engineering Concrete Structures and Commentary”. The test method performed shall be the hydrostatic test with maximum allowable loss of 0.50% of the test water volume in 24 hours.

2. Testing procedure for concrete vessels.

a. Clean the exposed concrete surfaces of the vessel, including the floor, of all foreign material and debris. Mud, soil, or other foreign material may temporarily fill defects, voids, or cracks, giving test results that may not reflect the true condition of the tank. The concrete surfaces and concrete joints shall be thoroughly inspected for potential leakage points. Areas of potential leakage shall be repaired prior to filling the tank with water.

b. All openings, fittings, and pipe penetration in the vessel shell shall be inspected. Defective or cracked concrete shall be repaired.

c. All vessel penetrations and outlets shall be securely sealed to prevent the loss of water from the vessel during the test.

d. Vessel penetrations and pipe, channel, and conduit outlets shall be monitored before and during the test to determine the water tightness of these appurtenances. Leakage at these outlets shall be repaired prior to test measurements. No allowance shall be made in test measurements for uncorrected known points of leakage. The flow from the under- drain system shall be monitored during this same period and any increase in flow shall be recorded.

e. The ground water level shall be brought to a level below the top of the base slab and kept at that elevation or at a lower elevation during the test.

f. The initial filling of a new vessel shall not exceed a rate of four (4) feet per hour. Filling shall be continued until the water surface is at the design maximum liquid level.

g. The water shall be kept at the test level of the vessel for at least three days prior to the actual test for moisture absorption by the concrete and temperature stabilization of the test water.

h. The test measurements shall not be scheduled for a period when the forecast is for a substantial change in weather pattern.

i. The vertical distance to the water surface shall be measured from a fixed point on the vessel above the water surface. Measurements shall be recorded at 24 hour intervals. The water temperature shall also be recorded (at a depth of 18 in. below the water surface). The Contractor shall obtain certification of the periodic test conditions from the General Contractor or Owner’s representative.

j. The test period shall be at least the theoretical time required to lower the water surface 3/8 in. assuming a loss of water at the maximum allowable rate. The test period need not be longer than five days.

k. A floating, restrained, partially filled, calibrated, open container for evaporation and precipitation measurement should be positioned and the water level in the container recorded. If feasible, place the pail in the shallow area of the pool to maintain consistent water temperatures between the two. Mark the level of water within the pail and the pool. The Contractor shall obtain certification of the initial test conditions from the General Contractor or Owner's representative.

l. The change in water volume in the vessel shall be calculated and corrected for evaporation, precipitation, and temperature. If the loss exceeds the required criteria, the vessel shall be considered to have failed the test. The vessel shall also be considered to have failed the test if water is observed flowing or seeping from the vessel.

m. A restart of the test shall be required when test measurements become unreliable due to unusual precipitation or other external factors.

n. If the test fails, the Pool Contractor, at their expense, shall identify and correct any defects resulting in water loss. Following correction of any defects, the test shall be repeated. This process shall be continued until a passing test is obtained. All work involving repairs, corrections, and retesting (including cost of water) shall be at the sole expense of the Pool Contractor.

C. Soils and material testing.

a. Perform soils testing in accordance with the recommendations contained within the geotechnical report.

b. Perform material testing in accordance with the requirements of this Division and Division 3 – Concrete.

3.04 INSTALLATION

A. Install all equipment and materials in accordance with manufacturer's requirements and recommendations, referenced standards, and standard industry practices.

B. All work is to be installed in coordination with the construction schedule. Any additional mobilizations are the responsibility of the Pool Contractor.

C. All lap and lesson pools shall be constructed to 75'-1" in length as measured to the finish surface of the pool with a tolerance of -0" and +2". All other pool and spa dimensions shall be constructed with a tolerance of -1" and +1".

3.05 STARTUP

A. Perform system start-up. Coordinate schedule with General Contractor.

1. The Pool Contractor is responsible for start-up of all pool systems and balancing of flow rates.

a. A qualified representative of the Pool Contractor or manufacturer shall put all equipment into operation and perform all systems adjustments and calibration for proper operations.

b. Pool fill water supplied by Owner.

c. Pool Contractor shall furnish necessary chemicals to achieve water chemistry balance required by local jurisdiction for operation and within general industry standards through turnover.

1) Water balance shall consider Langlier saturation index, total alkalinity, calcium hardness, pH, free and total chlorine.

2) The Langlier saturation index shall be maintained between -0.5 and +0.5 after the pool is brought up to design operating temperature.

d. Pool Contractor shall maintain a daily log of water chemistry from system startup until turnover of operations to the Owner.

e. Pool Contractor shall maintain the operations of the systems and chemical balancing until final acceptance by Owner.

f. Following start-up, Pool Contractor shall furnish three (3) charges of perlite media for each regenerative media filter system.

B. Provide owner training.

1. A qualified representative from the Pool Contractor or manufacturer shall provide the required training on each piece of equipment.

2. Review and instruct the Owner's representative(s) on the proper operations, maintenance, and cleaning of the systems and equipment.

3. All training shall be digitally recorded. A digital copy of the training videos and sessions shall be provided to the Owner.

4. Training shall include 32 hours on site training and include the following:

a. 8 hours initial training.

b. 8 hours after Owner's staff has had 2 weeks experience operating the system.

c. 8 hours; 4 weeks after the 2nd training session.

d. Minimum 4 hours winterization training of outdoor pools.

e. Minimum 4 hours spring startup training of outdoor pools.

3.06 ADJUSTING

A. Perform all system adjustments necessary for proper operations and conformance with applicable jurisdictional requirements prior to final acceptance.

3.07 CLEANING

A. Completely clean entire gutter and pool of formwork immediately following form removal.

B. Thoroughly clean work area and all finishes, equipment, accessories, and appurtenances following completion of work and prior to final acceptance.

3.08 WINTERIZATION

A. Pool shall not remain drained during the winter or offseason.

B. Winterizing instructions for facility closure shall identify proper instructions for draining and winterizing of the pool and its systems.

C. All piping to be sloped to low point for easy winterization where feasible. If low point winterization is possible, install a 2-inch PVC ball valve at the low point with piping to waste

or grade (with air gap as required). All other pipes to be blown out with compressed air for removal of all water for winterization.

D. Pool Contractor shall perform winterization and spring start-up of the outdoor pools following the first regular pool season. The Pool Contractor shall include all labor and materials costs as necessary. All materials required for winterizing (i.e. plugs, etc.) shall be furnished by the Pool Contractor and provided to the Owner for continued use following completion of the work.

E. If the project schedule includes completion and a Grand Opening event within the regular winter season, the Pool Contractor shall include an additional winterization and spring start-up to allow for operation of the outdoor pools during the Grand Opening event.

END OF SECTION

SECTION 13 11 14.5

SHOTCRETE FOR POOLS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Pneumatically applied concrete for water-retaining spa vessels.

1.02 RELATED REQUIREMENTS

A. Section 01 30 00 - Administrative Requirements.

B. Section 01 40 00 - Quality Requirements.

C. Section 03 20 00 - Concrete Reinforcing.

D. Section 03 30 00 - Cast-in-Place Concrete.

E. Section 07 92 00 - Joint Sealants.

1.03 REFERENCE STANDARDS

A. Reference Standards

1. The work in this section is subject to the requirements of applicable portions of the following standards:

a. ACI 506.2 - Specification for Shotcrete 2013 (Reapproved 2018).

b. ACI 506.3R - Guide to Certification of Shotcrete Nozzlemen.

c. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete 2018a.

d. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete 2018.

e. ASTM C33/C33M - Standard Specification for Concrete Aggregates 2018.

f. ASTM C42 - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.

g. ASTM C150/C150M - Standard Specification for Portland Cement 2021.

h. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete 2010a (Reapproved 2016).

i. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.

j. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete 2019.

k. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.

l. ASTM C989 - Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars.

m. ASTM C1140 - Standard Practice for Preparing and Testing Specimens from Shotcrete Test Panels.

n. ASTM C1141 - Standard Specification for Admixtures for Shotcrete.

o. ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures.

p. ASTM C1604 - Standard Test Method for Obtaining and Testing Drilled Cores of Shotcrete.

q. COE CRD-C 48 - Handbook for Concrete and Cement Standard Test Method for Water Permeability of Concrete 1992.

r. NSF 61 - Drinking Water System Components - Health Effects 2020.

s. NSF 372 - Drinking Water System Components - Lead Content 2020.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Pre-installation Meeting: Convene one week before starting work of this section.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Submit detailed product information identifying types and quality of materials, including admixtures.

C. Shop Drawings: Indicate formwork, dimensions, reinforcement, and accessories.

D. Nozzle operator ACI 506.3 certifications.

E. Mix Design Data:

1. The Contractor shall be responsible for shotcrete mixture proportioning. Submit the proposed shotcrete mixture proportions to the Engineer for review and approval at least 10 working days before preconstruction trials. For each shotcrete mixture design, submit the following information:

a. Proof that the proposed mixture design is capable of meeting the specified performance requirements.

b. Water/cement ratio, source, size and amount of aggregates and admixtures.

1.06 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 506.2.

1. Maintain one copy of document on site.

B. An independent testing agency will provide inspection and testing services, as specified in Section 01 40 00 - Quality Requirements.

C. Applicator Qualifications: Company specializing in performing shotcrete installations, with minimum 5 years of documented experience.

D. Nozzle operators shall be certified in the application of shotcrete per ACI 506.3R.

E. Provide inspection for compliance with design mix.

F. Provide test panels as noted in 1.07.

G. Modify mix design as required based on results of testing.

1.07 TEST PANELS

A. Sample Panel: Provide mock-up of sufficient size to indicate special treatment or finish required.

B. Sample Panel: Construct two panels, 2 feet long by 2 feet wide, to indicate range of special treatment or finish required.

C. Test Panels: Prior to starting work provide mock-up for evaluation of materials and workmanship:

1. Provide two test panels fabricated by placing shotcrete onto plywood for each mix design being considered, for each shooting position to be encountered, and for each 50 yd^3 of placed shotcrete.

2. Form panels to identical shotcrete thickness of typical walls and with most congested reinforcement in place. Panels shall be shot at the same angle, using the same nozzleman and with the same concrete mix design that will be used on the project. The equipment used in constructing the test panels shall be the same equipment used in the construction.

3. Strength Tests: 3 cores from each panel will be taken for testing in accordance with ASTM C1140 to determine the compressive strength of the shotcrete. Test results to be acceptable shall meet the acceptance criteria of ACI 506.2, paragraph 1.6.2.4.

4. Cores to meet Core Grade 2, per definitions in ACI 506.2.

5. If test panels to remain as part of the Work, repair core holes after testing, in accordance with ACI 506.2.

D. Locate test panels where directed.

1.08 FIELD CONDITIONS

A. Maintain material and surrounding air temperature at minimum 50 degrees F (10 degrees C) prior to and during installation and maintain material at this minimum temperature for 7 days after completion of work. Provide equipment and cover to maintain minimum temperature.

B. Suspend shotcrete operations during high winds, rainy weather, or near freezing temperatures when work cannot be protected.

PART 2 PRODUCTS

2.01 MATERIALS

A. Cement: ASTM C150/C150M, Type I or II.

B. Fly ash, pozzolan and ground granulated blast-furnace slag:

1. Maximum 25 percent substitution of cement by total weight.

2. Fly ash or other pozzolan shall conform to ASTM C618 for Class N or F materials.

3. Ground-granulated blast-furnace slag shall conform to ASTM C989.

4. Silica Fume shall conform to ASTM C1240.

C. Aggregate: Normal weight, ASTM C33/C33M, 3/4 inch (9 mm) maximum size.

D. Admixtures: Chemical type complying with ASTM C494/C494M (wet mix only).

E. Air-Entraining Admixture: Complying with ASTM C260/C260M (wet mix only).

F. Microbiologically-Induced Corrosion-Inhibiting Admixture: Resists growth of bacteria and fungi on or inside concrete.

1. Manufacturers:

a. ConShield Technologies, Inc; ConShield HD: www.conshield.com/#sle.

b. Penetron; BioMIC: www.penetron.com/#sle.

c. Substitutions: See Section 01 60 00 - Product Requirements.

G. Waterproofing Admixture: Admixture formulated to reduce permeability to liquid water, with no adverse effect on concrete properties.

1. Admixture Composition: Crystalline, functioning by growth of crystals in capillary pores.

2. Potable Water Contact Approval: National Sanitation Foundation (NSF) certification for use on structures holding potable water, based on testing in accordance with NSF 61 and NSF 372

3. Manufacturers:

a. Penetron; PENETRON ADMIX SB: www.penetron.com/#sle.

b. Substitutions: See Section 01 60 00 - Product Requirements.

H. Reinforcing Bars: Type and size as indicated on drawings. Refer to Section 03 20 00, Concrete Reinforcing.

I. Reinforcing Mesh: ASTM A1064/A1064M steel welded wire reinforcement, plain type.

J. Water: ASTM C1602/C1602M; clean, potable, and not detrimental to shotcrete.

K. Moisture Cover Type:

1. Absorbent Covers: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry. These materials must be free of harmful substances, such as sugar or fertilizer, or substances that may discolor the concrete. To remove soluble substances, burlap should be thoroughly rinsed in water before placing it on the concrete.

2. Moisture Retaining Covers:

a. Plastic Film: ASTM C 171, 10 mil minimum thickness polyethylene film

b. White burlap-polyethylene sheet meeting ASTM C 171

c. Reinforced Curing Paper: Complying with ASTM C 171

d. Moisture Retaining Fabric: Conforming to ASTM C171: A naturally colored, non-woven polypropylene fabric with a 4-mil non-perforated reflective (white) polyethylene coating containing stabilizers to resist degradation from ultraviolet light. Fabric shall exhibit low permeability and high moisture retention.

1) Acceptable Manufactures/Products:

(a) PNA Construction Technologies, Inc.; Hydracure M15.

(b) Reef Industries Incorporated; Transguard 4000.

L. Bonding Compound: Polyvinyl acetate, re-wettable type;

1. Manufacturers/Products: Subject to compliance with requirements, provide the following:

a. "Eucoweld", Euclid Chemical Co;

b. "Daraweld C", W.R.Grace;

c. "Sonocrete", BASFAlignment

M. Wire: Small gauge, high strength steel wire.

2.02 SHOTCRETE MIX

A. Provide wet or dry mix design that gives good compaction and low percentage of rebound, is stiff enough not to sag.

B. Comply with following requirements:

1. Compressive Strength (28 day minimum): 4,000 psi (20 MPa).
2. Aggregate Size (maximum): 3/8” (5 mm).
3. Slump (plus or minus 1 inch): 2-1/2 inch (25 mm).
4. Air Content:
   a. Interior concrete: air content not specified
   b. Exterior concrete: 6% +/- 1.5% in place

C. Maintain quality control records during production of shotcrete; make records available.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that conditions are acceptable and are ready to receive work.

C. Verify that field measurements are as indicated on drawings.

D. Verify fabricated forms are:

1. True to line and dimension.
2. Adequately braced against vibration during placement.
3. Constructed to permit escape of trapped air during gunning operations.
4. Constructed to minimize rebound during gunning operations.

E. Verify correct placement of reinforcement with sufficient clearances to permit complete encasement.

F. Verify that embedded fittings, pipe, conduits, and other items are correctly and securely placed.

G. Ensure easy access to shotcrete surfaces for screeding and finishing, and to permit uninterrupted application.

3.02 PREPARATION

A. Remove existing unsound concrete from substrate surfaces.

1. Minimize abrupt changes in depth of area to be repaired.

B. Sandblast existing concrete surfaces to receive shotcrete if intention is to bond to existing concrete.

C. Determine operating procedures for placement in close quarters, extended distances, or around unusual obstructions where placement velocities and mix consistency may be adjusted during application.

D. Clean and wet cementitious or absorptive substrate surfaces prior to receiving shotcrete. Keep porous surfaces damp for several hours prior to placement of shotcrete.

E. Apply bonding agent to existing or previously placed concrete surfaces.

F. Protect adjacent surfaces not receiving shotcrete.

G. Verify formwork will serve adequately to withstand and permit rebound and fluid pressure of concrete.

3.03 ALIGNMENT CONTROL

A. Provide alignment wire to establish thickness and plane of required surfaces.

B. Install alignment wire at corners and offsets not established by forms.

C. Tighten alignment wire true to line. Position adjustment devices to permit additional tightening.

3.04 EQUIPMENT

A. Mixing Equipment: Capable of thoroughly mixing aggregate, cement, and water in sufficient quantity to maintain continuous placement.

B. Delivery Equipment: Capable of discharging wet mix aggregate, cement, and water accurately, uniformly, and continuously.

C. Mixing Equipment: Capable of thoroughly mixing dry aggregate and cement in sufficient quantity to maintain continuous placement.

D. Delivery Equipment:

1. Air Supply: Clean, dry air adequate for maintaining sufficient nozzle velocity, uniformly steady for work while simultaneously operating blow pipe for cleaning away rebound.

2. Capable of loading aggregate and cement mixture into delivery hose under full control while maintaining continuous stream of uniformly mixed material at required velocity to discharge nozzle.

3. Equip discharge nozzle with water injection system (water ring) for directing even distribution of water to aggregate and cement mixture.

E. Water Supply: Uniform water pressure at discharge nozzle sufficiently greater than operating air pressure to ensure intimate mixing with aggregate-cement mix; provide water pump to system if line water pressure is inadequate.

3.05 APPLICATION

A. Place reinforcement in accordance with ACI 506.2.

B. Use mixing and delivery equipment capable of thoroughly mixing aggregate, cement, and water in sufficient quantity to maintain continuous and uniform placement.

C. All shotcrete shall be shot within 90 minutes after addition of mixture water to the batch. Shotcrete loads shall be of such batch size that this requirement is met. This time limit may be extended, subject to approval by the Engineer, if proper use is made of set retarding or hydration controlling admixtures to maintain workability without retempering with water.

D. Do not place shotcrete on surfaces that are frozen, spongy, or where there is free water.

E. Achieve maximum compaction with minimum rebound.

F. Build-up to required thickness in multiple passes to achieve layering. Encase reinforcement with the first pass.

G. Allow each layer to take initial set before applying succeeding layers.

H. Do not permit applied shotcrete to sag, slough, or displace.

I. After initial set of final layer, remove excess material outside of forms and alignment lines.

J. Sandblast to remove laitance. Clean with air/water pressure jet.

K. Finish surface of final layer with natural gun finish.

L. Remove rebound at construction and expansion joints.

M. Remove rebound material that does not fall clear of work; discard salvaged rebound.

N. Maintain shotcrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of shotcrete.

O. Immediately after placement, protect shotcrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

P. Maintain surfaces wet for a minimum of 7 days.

Q. Apply curing compound to exposed surfaces according to manufacturer's instructions.

R. Sound test the applied material with hammer for voids. Expose voids and replace with new shotcrete ensuring full bond with adjacent work.

3.06 FIELD QUALITY CONTROL

A. Provide additional test panels during the course of the work as may be requested by the testing agency.

3.07 PROTECTION

A. Do not permit applied work to damage adjacent surfaces.

3.08 SCHEDULES

A. Spa Shell: Shotcrete, reinforced, wood float finish, to receive ceramic tile finish.

END OF SECTION

SECTION 13 11 15

SWIMMING POOL FINISHES

PART 1 GENERAL

1.01 SUMMARY

A. This section includes pool finishes.

B. Products Furnished Under This Section

1. Ceramic tile.
2. Pre-cast coping.
3. Cementitious bonding coat.
4. Exposed aggregate pool finish.
5. Cement-based waterproof coating.
6. Gutter grating.
7. Caulking.

C. Related Documents

1. Section 09 30 00.
2. Section 13 11 13.

1.02 REFERENCES

A. Reference Standards

1. The work in this section is subject to the requirements of applicable portions of the following standards:
    a. Referenced standards in Section 09 30 00.
    b. CRD-C 506 – Corps of Engineers Test Method for Evaluation of Hot-Applied Joint Sealants for Bubbling Due to Heating.
    c. ASTM C109 – Standard Test Method for Compressive Strength of Hydraulic Cement Mortars.
    d. ASTM C 321 - Standard Test Method for Bond Strength of Chemical-Resistant Mortars.
    e. ASTM C 348 - Standard Test Method for Flexural Strength of Hydraulic Cement Mortars,
    f. ASTM C 596 - Standard Test Method for Drying Shrinkage of Mortar Containing Hydraulic Cement.
    g. ASTM C920 – Standard Specification for Elastomeric Joint Sealants.
    h. ASTM C1028 – Standard Test Method for Determining the Static Coefficient of Friction or Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method.
    i. ASTM E903 – Standard Test Methods for Solar Absorptance, Reflectance, and Transmittance of Materials Using Integrating Spheres.
    j. ASTM G154 – Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials.

k. ANSI 118.7 – High Performance Cement Grouts for Tile Installation.

l. ANSI/APSP/ICC/NPC-12 2016 – American National Standard for the Plastering of Swimming Pools and Spas.

m. COE CRD-C 48-92 - Method of Test for Water Permeability of Concrete: U.S. Army Corps of Engineers.

n. NSF/ANSI Standard 61 - Drinking Water System Components - Health Effects (for use of waterproofing material on structures holding potable water).

o. National Plasterer's Council Technical Manual – Tenth Edition.

p. Utah Code R392-302: Design, Construction, and Operation of Public Pools (Current Revision)

q. b. Salt Lake Valley Health Department Health Regulation #2: Design, Construction, and Operation of Pools Regulation (Current Revision)

r. OSHA Rules and Regulations.

1.03 SUBMITTALS

A. Provide submittals in accordance with Division 1 – General Requirements.

B. Provide the following submittals.

1. Product data or submittals requested by the General Contractor, Owner, or Engineer.
2. Ceramic tile and coping – see Section 09 30 00.
3. Cementitious bonding coat.
    a. Product information and manufacturer's installation instructions.
4. Exposed aggregate pool finish.
    a. Product information and manufacturer's installation instructions.
    b. Batch numbers of bags used (for warranty purposes).
    c. Prepare a 12" square panel at the site demonstrating color and texture for pool plaster. Finished plaster work shall match the approved sample panel.
    d. Exposed aggregate pool finish manufacturer's completed warranty form for each pool vessel. Include the list of all Batch Numbers utilized on the pool vessel.
5. Cement-based waterproof coating.
    a. Product information and manufacturer's installation instructions.
6. Grating
    a. Manufacturer's product data submittals.
    b. Two (2) samples of each material specified (including curb angle), minimum 12" length.
7. Caulking.
    a. Product information and manufacturer's installation instructions.

1.04 PERFORMANCE REQUIREMENTS

A. Ceramic tile and coping – see Section 09 30 00.

1.05 QUALITY ASSURANCE

A. Ceramic tile and coping – see Section 09 30 00.

B. Exposed aggregate pool finish.

1. Furnish product of company specializing in manufacture of exposed aggregate pool finishes with minimum experience of 15 years.

2. Installer must be certified by coating manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Refer to requirements in Section 13 11 13.

1.07 WARRANTY

A. Refer to requirements in Section 13 11 13.

B. Exposed aggregate finish manufacturer shall provide a five year pro-rated material warranty.

1.08 EXTRA MATERIALS

A. Ceramic tile and coping – see Section 09 30 00.

B. Exposed aggregate pool finish.

1. Furnish one bag of each batch used in mix to Owner with description of mix ratio used and installation instructions (for Owner's use in making repairs).

1.09 MAINTENANCE

A. Ceramic tile and coping – see Section 09 30 00.

PART 2 PRODUCTS

2.01 CERAMIC TILE AND COPING

A. See Section 09 30 00.

2.02 CEMENTITIOUS BONDING COAT

A. SGM Bond Kote as manufactured by Southern Grouts and Mortars, or equal.

1. Bond coating material shall be supplied and recommended for use with exposed aggregate finish by the aggregate finish manufacturer.

2. Water: Potable water without detrimental minerals, metals, hardness, or alkalinity. If in doubt, verify quality with coating manufacturer.

2.03 EXPOSED AGGREGATE PLASTER FINISH

A. SGM Diamond Brite exposed aggregate finish as manufactured by Southern Grouts and Mortars, or equal.

1. 100% quartz aggregate.

a. Quartz aggregates must be supplied by manufacturer of coating material.

2. Polymer modified cement.

3. Color: Diamond Brite "Blue".

4. Use only pre-blended products.

5. Furnish enough material to have sufficient quantity for replacement of unsatisfactory work.

2.04 CEMENT-BASED WATERPROOF COATING

A. Basecrete cementitious compound as manufactured by Basecrete Flexible Waterproofing Technologies, or equal.

1. Blend of rapid-drying Portland cement, uniquely treated quartz sand and a compound of active proprietary chemicals with the following characteristics:
    a. Color: White.
    b. Aggregate: Compound / Powder.
    c. Potable water: (NSF/ANSI Standard 61) Certification for potable water structures.
    d. Permeability: (CRD-C 48-92) No measurable leakage through waterproofed concrete, when tested at 460 feet (140 m) head or 200 psi (14 bar), positive or negative water pressure.

B. Basecrete cementitious flexible waterproofing membrane (BC-L0145 | BC-L0617) as manufactured by Basecrete Flexible Waterproofing Technologies, or equal.
    1. Blend of rapid-drying Portland cement, uniquely treated quartz sand and a compound of active proprietary chemicals with the following characteristics:
        a. Compressive Strength: (ASTM C109) 6500 psi | 48.6 MPa.
        b. Flexural Strength: (ASTM C-348) 2380 psi | 16.41 MPa.
        c. Shrinkage: (ASTM C-596) 0.03%.
        d. Adhesion/Bond: (ASTM C-321)
            1) Concrete 1372 psi | 9.46 MPa.
            2) Steel 1144 psi | 7.89 MPa / Bond 720 psi | 4.96 MPa.
        e. Potable water: (NSF/ANSI 61) Certification for potable water structures.

C. Water: Clean cleat, non-alkaline and free of salts and other harmful elements; potable.

2.05 GRATING

A. Quietflow parallel grating as manufactured by Lawson Aquatics, Daldorado, or equal.
    1. Sections of UV-stabilized PVC parallel grating, with a depth of 1.0”.
    2. UV-stabilized PVC curb angle shall be supplied by grating manufacturer.
    3. Components must meet ASTM G154 standards, requiring finished products to withstand 750 hours UV exposure.
    4. The top surface must have a raised, non-slip pattern to meet the static coefficient of friction, while wet or dry, in accordance with ASTM C1028.
        a. The top surface shall comply with federal ADA regulations.
    5. The space between the pieces must not exceed 0.375” and provide a minimum of 37.5% open area per foot to allow unrestricted water flow.
    6. Grating must meet or exceed ASTM E661, which states allowable deflection at 200 lbs. and load to failure criteria.
    7. All grating and curb angles are to be secured with stainless steel hardware (Grade 316). All fastening hardware shall be supplied by the manufacturer.
    8. Radius sections of grating must be on-site adjustable to conform to the constructed profile of the pool.
    9. Color selection for pools shall be Bone.
    10. Color for alternate products shall be selected from standard palette by Owner/Architect.

2.06 CAULKING

A. DECK-O-SEAL as manufactured by deck-o-seal, a division of W.R. Meadows, or equal.
   1. Primer: Rezi Weld LV as manufactured by W.R. Meadows, or equal.
   2. Liquid, self-leveling.
   3. 24-hour cure time.
   4. Product shall be recommended for use in sealing joints on swimming pool decks.
   5. Product shall be acceptable for interior and exterior use.
   6. Elongation: 500%+
   7. Tensile Strength: 125 PSI
   8. Color: Selection by Architect/Owner from standard palette.

B. DECK-O-SEAL 125 as manufactured by deck-o-seal, a division of W.R. Meadows, or equal.
   1. Primer: Rezi Weld LV as manufactured by W.R. Meadows, or equal.
   2. Liquid, self-leveling.
   3. 24-hour cure time.
   4. Product shall be recommended for use in swimming pool floor joints and submerged applications.
   5. Elongation: 400%+
   6. Tensile Strength: 125 PSI
   7. Color: Dura-White

C. DECK-O-SEAL GUN GRADE as manufactured by deck-o-seal, a division of W.R. Meadows, or equal.
   1. Primer: Rezi Weld LV as manufactured by W.R. Meadows, or equal.
   2. 24-hour cure time.
   3. Product shall be recommended for use in sealing joints on pool sidewall and submerged applications.
   4. Elongation: 400%+
   5. Tensile Strength: 125 PSI
   6. Color: Dura-White

PART 3 EXECUTION

3.01 EXAMINATION

A. Field verify conditions prior to start of work and notify General Contractor of any discrepancies between encountered conditions and those indicated within the Drawings and herein.

B. Ceramic tile and coping – see Section 09 30 00.

3.02 PREPARATION

A. Protect all adjacent surfaces, equipment, etc. to remain from damage during course of work. Restore any damaged areas or equipment.

B. Prepare all surfaces in strict accordance with the manufacturer's requirements.

C. Ceramic tile and coping – see Section 09 30 00.

D. Cementitious bonding coat.

1. Application of bonding coat and subsequent plastering shall not be started until the pool recirculation, filtration, and chemical feed system is installed and ready for operation.
2. Do not begin installation until concrete pool shell has cured at least 28 days.
3. Prepare surface in strict accordance with manufacturer's instructions.
4. Examine pool surfaces to identify conditions that might interfere with proper bonding of coating.
5. Make surface sufficiently rough to provide a strong mechanical bond.
6. Clean pool surfaces of all material that might interfere with proper bonding of coatings.
7. Clean with high-pressure water immediately prior to bonding coat application.
8. Let pool drain until there is no standing water present.

E. Exposed aggregate pool finish.

1. Prepare surface in strict accordance with manufacturer's instructions.
2. Environmental and temperature conditions shall be in strict accordance with manufacturer's installation instructions.
3. Apply cementitious bonding coat.
4. Wait minimum 6 hours, maximum 3 days following application of bond coat prior to plastering.
5. If plaster is not applied same day as bonding coat, thoroughly wash down entire surface with "jet nozzle" hose to ensure bonding coat is clean and free of dirt, efflorescence, and other contaminants.
6. Mist bonding coat with clean cool water prior to plastering to permit proper hydration.

F. Cement-based waterproof coating.

1. Prepare surface in strict accordance with manufacturer's requirements. Follow manufacturer's instructions to clean and prepare surfaces and seal cracks and joints.
2. Remove remaining concrete fins and projections, and general surface dirt.
3. Remove grease, oil and other contaminants. Use high-pressure water blasting, wet or dry sand blasting, wire brush if applicable or other methods recommended by waterproofing manufacturer to produce surfaces suitable ("tooth and suction") for application of waterproofing, minimum ICRI CSP 3 profile. Do not apply to smooth slabs.
4. Rout out faulty construction joints and visible cracks not subject to movement, exceeding 0.02" (0.4 mm) in width to approx. 3/4" (20 mm) width and minimum 1" (25 mm) depth.
5. Remove all protrusions, work back to sound concrete and chisel out any spalled or honeycombed areas.
6. Roughen form tie holes.
7. Stop active water leakages as per manufacturer's specifications.
8. Rinse surfaces to be waterproofed several times so that the concrete is thoroughly saturated. Surfaces shall be moist but not wet when waterproofing system is applied. Remove any surface water on horizontal surfaces.

G. Grating

1. Ensure pool gutter is thoroughly cleaned and the appropriate finish has been installed prior to starting installation of grating and supports.

H. Caulking

1. Concrete should be completely cured and free from all foreign materials and contamination from curing agents. Do not begin installation until concrete pool shell has cured at least 28 days.
2. For proper adhesion, joints must be clean and dry. Remove foreign substances, incompressibles, and free water from joint opening.
3. To maintain cleanliness around the joint to be sealed, apply masking tape 2” wide to the surfaces adjoining both sides of the joint before primer or caulking are applied.
4. Control depth of sealant subject to submersion with suitable expansion joint (to support the weight joint sealant is subject to).
5. Apply primer in accordance with manufacturer’s instructions.
6. Apply primer to properly prepared joint surfaces by brush, depositing a light, continuous film. Do not over-apply.
7. Primer must be tacky to the touch and not allowed to dry before applying sealant to the joint.

3.03 INSTALLATION

A. Install all products in strict conformance with manufacturer’s instructions.

B. Ceramic tile and coping – see Section 09 30 00.

C. Cementitious bonding coat.

1. Ensure proper temperatures are maintained per manufacturer’s requirement during installation and curing.
2. Install bonding coat to all interior pool surfaces (walls and floors) receiving exposed aggregate finish.
3. Apply bonding coat, let material set for approximately one (1) minute, then rough up surface to desired finish with clean textured roller.
4. Ensure application is uniform in thickness and texture.

D. Exposed aggregate pool finish.

1. Ensure proper temperatures are maintained per manufacturer’s requirement during installation and curing.
2. Mix coating to produce best quality and consistent color throughout. If material from more than one batch number is used, mix all batches together for color consistency.
3. Mist the shell with cool, clean potable water. Do not apply plaster to areas with standing water. Do not apply plaster to hot, dry shells.
4. Apply finish plaster to nominal ½” thickness at all locations. Apply, trowel, and expose aggregate using methods and sequence selected from manufacturer’s recommended options to produce the most uniform finish.
5. Avoid practices that may cause washouts, shadows, streaks, or discoloration and repair all areas with stated characteristics.

6. Expose aggregate per manufacturer's instructions.
7. When plastering of the entire pool cannot be completed in one day, apply plaster surface up to established pool control joints or install ceramic tile joint between adjacent applications.
8. Ensure completed plastered areas remain continually hydrated via sprinklers, etc. when complete pool plastering installation cannot be completed in one (1) day.
9. Allow coating to air dry before filling pool. Avoid filling too soon causing mottling. Avoid drying out causing shrinkage cracking.
10. Fill pool completely and without interruption with clean, potable water. Start pool recirculation and filtration system once an adequate water level is present.
    a. First Day: Add sequestering agent upon initial fill per manufacturer's instructions and maintain water circulation for 24 hours prior to balancing pool chemistry.
    b. Second Day: Record pH, total alkalinity, calcium hardness and temperature levels. Adjust pH to 7.4-7.6 and total alkalinity to 80-120 PPM. Dissolve all chemicals completely in water before adding to pool, and allow sufficient time for each chemical to be fully dispersed before adding other chemicals. Do not add chlorine or calcium chloride.
    c. Third Day: Repeats steps from Second Day. Adjust chemistry to the following levels.
        1) Free Chlorine: 1.0 - 3.0 PPM
        2) pH: 7.4 - 7.6
        3) Total Alkalinity: 80 - 120 PPM
        4) Calcium Hardness: 200 - 400 PPM
        5) Stabilizer: 30 - 100 PPM
    d. Test and record water chemistry values once a week thereafter, and adjust to jurisdiction requirements and as indicated per manufacturer recommendations until final acceptance by Owner.
    e. Brush entire surface twice daily for the first three (3) days.
    f. Brush entire pool, walls and floor daily for the first two (2) weeks.
    g. Brush entire pool, walls and floor weekly thereafter and remove any debris and foreign materials immediately to prevent staining until final acceptance by Owner.
11. Replace areas of non-uniform appearance and areas with inadequate surface bond.

E. Cement-based waterproof coating.
1. Applicability: Shall be used to finish all pool gutters and interior walls and floors of all surge tanks and backwash pits.
2. Apply waterproofing material in quantities as per manufacturer's specifications and recommendations.
3. Cavity Fill:
    a. Prime cavities at cleaned and prepared faulty construction joints, cracks, form tie holes, etc. with waterproofing material and fill flush to surface with patching compound in mortar type consistency.

b. Laminate patching compound in 2 to 3 layers as per manufacturer's instructions for larger spalled or honeycombed areas.

4. Horizontal and Vertical Construction Joints:

a. Prime seal strips/ reglets in pre-formed 1" x 1" (25 x 25 mm) cavities with waterproofing material and fill flush to surface with patching compound (mortar consistency.)

5. Horizontal surfaces:

a. Dry-sprinkle waterproofing material to freshly poured slabs at 2.0 lb/sq.yd. (1.0 kg/sq.m) and power or hand trowel.

b. Dry distribute to pre-watered mud slab or existing slab to receive another topping at 2.25 lb/sq.yd. (1.2 kg/sq.m) immediately prior to casting the structural slab or new topping. Alternatively apply in slurry form. Contact manufacturer for guidance. info@basecreteusa.com P. 941-312-5142

c. Brush or spray apply waterproofing material in slurry consistency, in one coat on existing slabs.

1) For standard applications, apply at rate of 2.0 lb/sq.yd. (1.0 kg/sq.m).

2) For applications in contact with salt or wastewater, apply at rate of 2.5 - 2.8 lb/sq.yd. (1.4 to 1.5 kg/sq.m).

3) Spread material evenly and work it well into the surface.

6. Vertical Surfaces:

a. Apply base coat of waterproofing material in slurry consistency at uniform rate of 1.25 - 1.4 lb/sq.yd. (0.7 to 0.75 kg/sq.m). Apply using appropriate compressed-air spray equipment, stiff masonry brush or stiff broom.

b. After base coat has reached initial set but is still "green" (tacky), apply finish slurry coat of waterproofing material at 1.25 -1.4 lb/sq.yd. (0.7 to 0.75 kg/sq.m). Apply so that final brush or broom strokes leave parallel, uniform texture. Use light pre watering between coats when rapid drying conditions occur.

7. Curing:

a. Follow manufacturer's general instructions for curing and hardening of waterproofing material.

b. Protect surfaces from rain, frost and drying out.

F. Grating.

1. Install curb angle and grating level and true to the pool wall and adjacent deck in strict accordance with manufacturer’s instructions utilizing fastener’s supplied by the manufacturer.

2. All gutter grating shall be installed flush with adjacent surfaces (coping and deck) within a tolerance of 1/8”.

3. Gaps between curb angle and grating at gutter to deck and gutter to coping interface shall not exceed 0.375”.

G. Caulking.

1. Applicability:

a. Utilize DECK-O-SEAL for all sealing joints at pool deck surface.

b. Utilize DECK-O-SEAL 125 or DECK-O-SEAL GUN GRADE for all submerged horizontal pool floor joints.

c. Utilize DECK-O-SEAL GUN GRADE for all submerged vertical pool wall joints.

2. Ensure proper temperatures are maintained per manufacturer's requirement during installation and curing.

3. Apply primer in accordance with manufacturer's instructions.

4. Mix material in accordance with manufacturer's instructions.

5. Apply thoroughly blended material with a hand- or air-operated caulking gun, putty knife, or trowel.

6. Tool sealant beads with tools wetted with clean water.

7. Remove masking tape before sealant begins to set.

8. Allow material to cure for 24 hours minimum prior to filling of pool (@ 77 degrees F, allow longer periods for colder temperatures).

3.04 CLEANING

A. Clean all adjacent surfaces as required. Ensure finished surfaces (tile, pavers, etc.) are completely clean of any debris, plaster, sealants, etc.

B. Ceramic tile and coping – see Section 09 30 00.

3.05 PROTECTION

A. Ceramic tile and coping – see Section 09 30 00.

B. Exposed aggregate pool finish.

1. Provide minimum cure time of 28 days prior to draining pool.

2. Do not operate automatic pool cleaners for 28 days. Do not vacuum the pool with a wheeled vacuum for 14 days.

C. Grating.

1. Protect finished grating surface from damage resulting from construction.

a. If significant construction foot traffic is expected on the finished gutter, cover appropriately for protection.

b. Promptly clean and remove all debris and dirt, etc. to protect from staining.

END OF SECTION

SECTION 13 11 16
SWIMMING POOL PIPING & VALVES

PART 1 GENERAL

1.01 SUMMARY

A. This section includes pool piping, valves, insulation, hardware, and accessories.

B. Products Furnished Under This Section

1. PVC Schedule 40 piping & valves.
2. PVC Schedule 80 piping & valves.
3. CPVC Schedule 40 piping & valves.
4. Pipe insulation.
5. Y-strainers.
6. Hardware, supports, and hangers.
7. Pipe penetration seals and sleeves.

C. Related Documents

1. Section 13 11 13.

1.02 REFERENCES

A. Reference Standards

1. The work in this section is subject to the requirements of applicable portions of the following standards:
   a. ASTM C195 – Standard Specification for Mineral Fiber Thermal Insulating Cement.
   b. ASTM C449 – Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
   c. ASTM C534 – Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
   d. ASTM C547 – Standard Specification for Mineral Fiber Insulation.
   e. ASTM C547-19 – Standard Specifications for Mineral Fiber Pipe Insulation.
   f. ASTM C 553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
   g. ASTM C612 – Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
   h. ASTM C921 – Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
   i. ASTM C1136 – Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
   j. ASTM C 1290 - Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Duct.
   k. ASTM C1393 – Standard Specification for Perpendicularly Oriented Mineral Fiber Roll and Sheet Thermal Insulation for Pipes and Tanks.
   l. ASTM C1696-20 – Standard Guide for Industrial Thermal Insulation Systems.
   m. ASTM D1784 – Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

n. ASTM D1785 – Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe,Schedules 40, 80, and 120.

o. ASTM D2464 – Standard Specification for Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings – Schedule 80.

p. ASTM D2466 – Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings – Schedule 40.

q. ASTM D2467 – Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings – Schedule 80.

r. ASTM D2564 – Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe & Fittings.

s. ASTM D2774 – Standard Practice for Underground Installation of Thermoplastic Pressure Piping.

t. ASTM D2855 – Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets.

u. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.

v. ASTM F441 – Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.

w. ASTM F493 – Standard Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe & Fittings.

x. ASTM F656 – Standard Specification for Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.

y. ASTM F2618 – Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Fittings for Chemical Waste Drainage Systems.

z. CSA B137.3-99 – Rigid Polyvinyl Chloride (PVC) Pipe for Pressure Applications.

aa. Utah Code R392-302: Design, Construction, and Operation of Public Pools (Current Revision)

bb. Salt Lake Valley Health Department Health Regulation #2: Design, Construction, and Operation of Pools Regulation (Current Revision)

cc. Virginia Graeme Baker Pool and Spa Safety Act (VGBA ANSI/APSP/ICC-16 2017).

dd. OSHA Rules and Regulations.

1.03 SUBMITTALS

A. Provide submittals in accordance with Division 1 – General Requirements.

B. Provide the following submittals.

1. PVC & CPVC pipe materials and valve product data sheets.
2. Pipe expansion and contraction product data sheets.
3. Pipe insulation product data sheets.
4. In-line modulating float valve product data sheets.
5. Y-Strainer product data sheets.

6. Pipe support hardware material data sheets.
7. Pipe penetration seals and sleeves product data sheets.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Refer to requirements in Section 13 11 13.

1.05 WARRANTY

A. Refer to requirements in Section 13 11 13.

PART 2 PRODUCTS

2.01 GRANULAR BEDDING MATERIAL

A. Provide free-draining granular materials for bedding and backfill of all pipe trenches.

1. Granular bedding material shall be a graded aggregate product of which 100 percent will pass the 25.0 mm (1 inch) sieve and not more than 10 percent will pass the 75um (#200) sieve.

2.02 PIPING & FITTINGS

A. PVC Schedule 40

1. All PVC Schedule 40 white pipe and fittings shall be produced from PVC Type I cell classification 12454, conforming to ASTM D1784 by Spears Manufacturing Company, or equal.

a. All injection molded PVC Schedule 40 white fittings shall be certified for potable water service by NSF International and manufactured in strict compliance to ASTM D2466.

b. Fabricated fittings are allowed for pipe sizes 10” and larger only. All fabricated fittings shall be produced in accordance with Spears General Specifications for Fabricated Fittings.

c. All PVC flanges shall be designed and manufactured to meet CL150 bolt pattern per ANSI Standard B16.5 and rated for a maximum internal pressure of 150 psi, non-shock at 73°F.

B. PVC Schedule 80

1. All PVC Schedule 80 pipe and fittings shall be produced from PVC Type I, cell classification 12454, conforming to ASTM Standard D1784 by Spears Manufacturing Company, or equal.

a. All injection molded PVC Schedule 80 fittings shall be certified for potable water service by NSF International and manufactured in strict compliance to ASTM D 2467.

b. Fabricated fittings are allowed for pipe sizes 10” and larger only. All fabricated fittings shall be produced in accordance with Spears General Specifications for Fabricated Fittings.

c. All PVC flanges shall be designed and manufactured to meet CL150 bolt pattern per ANSI Standard B16.5 and rated for a maximum internal pressure of 150 psi, non-shock at 73°F.

C. CPVC Schedule 40

1. All CPVC Schedule 40 pipe and fittings shall be produced from CPVC materials, cell classification 23447 conforming to ASTM Standard D1784 by Spears Manufacturing Company, or equal.
    a. All injection-molded fittings through 12” shall be manufactured in compliance to ASTM F439 and Certified by NSF International for use with potable water service.
    b. Fabricated fittings are allowed for pipe sizes 10” and larger only. All fabricated fittings shall be produced in accordance with Spears General Specifications for Fabricated Fittings.
    c. All CPVC flanges shall be designed and manufactured to meet CL150 bolt pattern per ANSI Standard B16.5.

D. Solvent Cement & Primer
1. The primer & cement used for connecting PVC piping & fittings shall be clear in color at all locations where the pipe is visible. The cement used for connecting CPVC piping and fittings shall be gray in color at all locations where the pipe is visible.
    a. Primer as manufactured by Spears Manufacturing Company, Primer-68 (clear), or equal.
    b. Solvent for PVC Schedule 40 & 80 as manufactured by Spears Manufacturing Company, PVC- 17 (clear), or equal.
    c. Solvent for CPVC Schedule 40 as manufactured by Spears Manufacturing Company, CPVC- 24 (gray), or equal.

2.03 VALVES

A. All valve bodies and components shall be non-metallic or stainless steel unless otherwise specified.

B. All valves two- and one-half inches (2-1/2”) and smaller in size shall be thermoplastic ball valves, True Union 2000 Industrial type as manufactured by Spears Manufacturing Company, or equal.
1. Valves shall be manufactured to ASTM F1970 and constructed from PVC Type I, ASTM D1784 Cell Classification 12454 or CPVC Type IV, ASTM D1784 Cell Classification 23447.
2. All o-rings shall be EPDM.
3. All valves shall have Safe-T-Shear stem with double o-ring stem seals.
4. All valve handles shall be polypropylene with built-in lockout mechanism.
5. All valve union nuts shall have Buttress threads.
6. All seal carriers shall be Safe-T-Blocked.
7. All valve components shall be replaceable.
8. All valves shall be certified by NSF International for use in potable water service.
9. All 1/2" through 2" valves shall be pressure rated to 235 psi, all 2-1/2" valves shall be pressure rated to 150 psi for water at 73° F.

C. All valves three inches (3”) and larger in size shall be thermoplastic butterfly valves as manufactured by Spears Manufacturing Company, or equal.

1. Valves shall be constructed from PVC Type I Cell Classification 12454 or CPVC Type IV Cell Classification 23447.
2. Valves 3”-6” in size shall be wafer butterfly style. Valves 8” and greater in size shall be standard butterfly style.
3. Valves 3”-8” shall be provided with lever operators.
    a. Lever operated valves shall be equipped with high impact polypropylene handle having built-in lockout capability and seven (7) position stops.
4. Valves 10” and larger shall be provided with gear operators.
    a. Gear operated valves shall be equipped with position indicator and a high impact polypropylene hand wheel.
5. All valve seats and o-rings shall be Buna-N, EPDM.
6. Seat shall be a non-liner type interlocked to valve body.
7. Bolt hole patterns shall conform to ANSI/ASME B16.5 Class 150.
8. Disc shall be offset design with fully isolated Type 316L stainless steel stem and Type 316 stainless steel hardware.
9. Valves shall be pressure rated at 150 psi for water at 73° F.

D. Check valves.
1. All check valves shall be constructed of non-metallic components, shall provide quick response shut-off in any position, and shall be suitable for horizontal or vertical installation.
2. All check valves three inches (3”) and smaller in size shall be thermoplastic True Union 2000 Industrial Ball Check type as manufactured by Spears Manufacturing Company, or equal.
    a. Check valve shall be manufactured to ASTM F1970 and constructed from PVC Type I, ASTM D1784, Cell Classification 12454 or CPVC Type IV, ASTM D1784 Cell Classification 23447.
    b. All o-rings shall be EPDM.
    c. All valve union nuts shall have Buttress threads.
    d. All valve seats shall be a standard o-ring type.
    e. All seal carriers shall be Safe-T-Blocked.
    f. All valve components shall be replaceable.
    g. All valves shall be certified by NSF International for use in potable water service.
    h. All PVC and CPVC 1/2" through 2" valves shall be pressure rated to 235 psi, all 2-1/2" and 3” valves shall be pressure rated to 150 psi, for water at 73°F.
3. All check valves four inches (4”) and larger in size shall be thermoplastic butterfly type as manufactured by Spears Manufacturing Company, or equal.
    a. Valve shall be constructed from PVC Type I, ASTM D1784 Cell Classification 12454 or CPVC Type IV, ASTM D1784 Cell classification 23447.
    b. Valves shall be flanged.
    c. All valve seals shall be reinforced EPDM and field replaceable.

d. All 4" through 8" valves shall be pressure rated at 150 psi, all 10" and 12" valves at 100 psi, for water at 73° F.

E. In-line modulating float valve.

1. Modulating float valves shall be of a non-corrosive, in-line mounted design as manufactured by Neptune-Benson Corporation, Mer-Made, or equal.

a. The in-line modulating float valve shall be an imbalanced butterfly valve design.

1) The internal valve disc of the modulating float valve shall be an imbalanced wafer type design to allow for pressure assisted opening from the pool water column.

b. The valve shall be operated through the open and closed position with 7” polyethylene floats attached to the float arms.

c. The valve shall be fully open with the floats down and 5% open with the floats in the up position.

1) Modulating float valves that are not of an imbalanced butterfly design to prevent sticking of the valve in the closed position and/or have more than a 5% open area in the closed position will not be approved as equals.

d. The in-line modulating float valve shall be installed between two companion flanges and shall have dual float arm positions that facilitate both horizontal and vertical in-line configurations.

e. The valve shall be constructed of a molded FRP flange, FRP wafer type disc, stainless steel valve body shaft, stainless steel linkage/stop pins and 7” polyethylene floats.

1) The FRP material used in manufacturing the valve body and valve disc shall be food grade Vinyl ester Resin and 3TEX glass.

2) The valve disc shall be designed for reliable main drain flow rate adjustment through the full operational range of the float valve and shall prevent sticking in the closed position.

3) The valve body shaft and linkage shall be machined from 316 stainless steel.

4) The modulating float valve shall be provided with 316 stainless steel stop pins seated in the clevis and valve body flange to provide position stops for both the open and closed positions.

5) The floats shall be blow molded polyethylene.

2.04 PIPE EXPANSION AND CONTRACTION

A. Expansion fittings shall be Triple O-ring Sealed Telescoping Design, as manufactured by Spears Manufacturing Company, or equal.

1. Expansion joints shall allow for a minimum of 3” of building structure movement.

2.05 PIPE INSULATION

A. Mineral-fiber, preformed pipe insulation:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Fibrex Insulations Inc.; Coreplus 1200.

b. Johns Manville; Micro-Lok.

c. Knauf Insulation; 1000 Pipe Insulation.

d. ArmaCell; AP ArmaFlex.

e. Owens Corning; Fiberglas.

2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified below. Nominal density is 4 lb/cu. ft. or more.

3. Molded closed cell polyethylene foam insulation is not an approved equal.

B. Insulation system shall include factory-applied jackets (ASJ) complying with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.

C. ASJ tapes shall comply with the following:

1. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.

a. Products: Subject to compliance with requirements, provide one of the following:

1) Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.

2) Compac Corp.; 104 and 105.

3) Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.

4) Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

b. Width: 3 inches.

c. Thickness: 11.5 mils.

d. Adhesion: 90 ounces force/inch in width.

e. Elongation: 2 percent.

f. Tensile Strength: 40 lbf/inch in width.

g. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

D. Adhesive materials shall be compatible with insulation materials, jackets, and substrates for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated. Mineral-fiber adhesive shall comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-82.

b. Foster Products Corporation, H. B. Fuller Company; 85-20.

c. ITW TACC, Division of Illinois Tool Works; S-90/80.

d. Marathon Industries, Inc.; 225.

e. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. ASJ Flashing Sealants.

1. Products: Subject to compliance with requirements, provide the following:

a. Childers Products, Division of ITW; CP-76.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.
6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

F. Insulation securements shall be aluminum bands: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing or closed seal.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Childers Products; Bands.
b. PABCO Metals Corporation; Bands.
c. RPR Products, Inc.; Bands.

G. Surface-burning characteristics for insulation and other related material shall comply with ASTM E84.
1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

2.06 Y-STRAINERS

A. Y-strainers shall be true union design with transparent PVC strainer body as manufactured by Asahi America, or equal. All O-rings shall be EPDM or FKM. Include optional clean out valve for 2” Y-strainers. Screen shall be 20 mesh PVC. Provide spare screen with each strainer.

2.07 HARDWARE

A. All fastening hardware shall be stainless steel or zinc plated steel.

2.08 SUPPORTS AND HANGERS

A. All supports, hangers, mounting equipment, anchors, etc. shall be constructed of non-corrosive materials (galvanized, stainless steel, FRP, etc.).

B. Supports and hangers can be clamp, saddle angle, spring, or other standard type.

2.09 PIPE PENETRATION SEALS AND SLEEVES

A. Modular pipe seals.
1. Modular pipe seals shall be Link-Seal modular seals manufactured by Garlock Sealing Technologies, or equal.
2. Model S-316.
a. Seal element: Black EPDM conforming to ASTM D2000 M3 BA510.
b. Pressure plates: Reinforced nylon polymer.
c. Bolts & nuts: 316 stainless steel.
d. Temperature range: -40 to 250 degrees F.

3. The seals shall be modular, mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and the wall opening.
4. The elastomeric element must be sized and selected per manufacturer's sizing procedure.
5. Coloration shall be throughout the elastomeric element for positive field inspection.
6. Each link must have a permanent identification of the size and manufacturer's name molded into it.

B. Pipe penetration sleeves.

1. Pipe penetration sleeves shall be Century-Line engineered pipe sleeves manufactured by Garlock Sealing Technologies, or equal.
2. Sleeve assembly.
   a. Sleeve material: Molded non-metallic high-density polyethylene.
   b. Waterstop: Integrally formed hollow water stop sized having a minimum of 4 inches larger than the outside diameter of the sleeve itself and allowing ½" movement between wall forms to resist pour forces.
   c. Each sleeve assembly shall have end caps manufactured of the same material as the sleeve itself.
3. Schedule 40 PVC pipe sleeves with solvent-welded PVC flange waterstops are an acceptable alternative to Century-Line sleeves.

PART 3 EXECUTION

3.01 EXAMINATION

A. Field verify conditions prior to start of work and notify General Contractor of any discrepancies between encountered conditions and those indicated within the Drawings and herein.

3.02 PREPARATION

A. Protect all adjacent surfaces, equipment, etc. to remain from damage during course of work. Restore any damaged areas or equipment.

B. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.03 INSTALLATION

A. Pipe trench excavation.

1. The Pool Contractor shall provide all trenching and backfill necessary for installation of underground pool piping.
2. Pipe subgrade stabilization (as required) and backfill shall be performed in conformance with the requirements of the geotechnical report.
3. Trench excavations shall conform to all OSHA requirements.
4. Pool Contractor shall provide dewatering in accordance with Section 13 11 13 as required. Dewatering shall be performed in accordance with the Civil Drawings, including all necessary erosion/sedimentation control measures.

5. Piping shall not be laid in standing water. If standing water is present, the trench shall be over- excavated and filled with a bedding layer of pea gravel and/or dewatered.
6. Provide granular bedding materials for all underground piping. Minimum bedding depth of 4" below bottom of pipe & fittings.
7. Backfill all piping with granular bedding materials and compact per the requirements of the geotechnical report. Provide minimum cover of 1" on the sides and 4" above top of pipe & fittings.

B. Pipe & fittings.
1. Material & class applicability.
   a. All piping, fittings, & valves within the recirculation system carrying water with temperatures less than 110 degrees Fahrenheit shall be PVC Schedule 40.
   b. All piping, fittings, & valves within the recirculation system carrying water with temperatures from 110 to 140 degrees Fahrenheit shall be CPVC Schedule 40.
   c. All piping, fittings, & valves within the recirculation system carrying water with temperatures 140 degrees Fahrenheit and greater shall be copper.
   d. All piping, fittings, & valves within the pool accessory systems (play feature, agitation, etc.) that are located underground or indoors shall be PVC Schedule 40.
   e. All piping, fittings, & valves within the pool accessory systems (play feature, agitation, etc.) that are located aboveground outdoors shall be PVC Schedule 80. Connections to Schedule 40 piping or fittings shall be made below ground.
2. Equipment & valve connections.
   a. All piping connections to equipment two and one-half (2 ½) inches and smaller in size shall be threaded connections, unless explicitly indicated within the Drawings.
   b. All piping connections to valves (true union) two and one-half (2 ½) inches and smaller in size shall be solvent welded, unless explicitly indicated within the Drawings.
   c. All piping connections to equipment and valves three (3) inches and larger in size shall be flanged connections, unless explicitly indicated within the Drawings.
3. Pipe & fittings shall be installed in accordance with the manufacturer's recommended instructions and the most recent ASTM Standard for installation applicable to the piping material and class.
   a. Spears "Plastic Pipe Handbook".
   b. PVC Schedule 40 & 80 – ASTM D1784 & ASTM D1785.
   c. CPVC Schedule 40 – ASTM D1784 & ASTM F441.
4. Piping must be labeled in accordance with the requirements in Section 13 11 13 and all jurisdictional requirements.
   a. Mark direction of flow.
   b. Mark pool and applicable system.

c. Mark each length of pipe between fittings. For pipe lengths longer than 15' linear length, provide markings at 10' intervals.

d. All exposed piping shall be painted and color-coded in accordance with Utah Code R392-302: Design, Construction, and Operation of Public Pools (Current Revision) and Salt Lake Valley Health Department Health Regulation #2: Design, Construction, and Operation of Pools Regulation (Current Revision)

e. All pipe crossings underground shall be separated by a minimum clear distance of 4". The separation shall be filled with compacted granular bedding materials, which shall be placed and compacted prior to placement and installation of the overlying crossing pipe.

5. Install tees to accept thermowells and sensors in each heat exchanger bypass piping.

a. Two (2) Pool each, three (3) Warm Spa each, two (2) Cold Spa each. Coordinate required adapter size for sensor with Division 25.

C. Pipe Expansion and Contraction

1. Make all necessary provisions for movement of piping that crosses building expansion joint.

D. Pipe Insulation

1. All piping within plenum spaces, as indicated in the Drawings, must be insulated according to local requirements and have surface burning characteristics complying with ASTM E84.
2. All pool fill piping must be insulated. *(include if: over finished space)*
3. All cold spa piping that is not buried must be insulated.
4. General insulation installation requirements.

a. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.

b. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified.

c. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

d. Install insulation with longitudinal seams at top and bottom of horizontal runs.

e. Install multiple layers of insulation with longitudinal and end seams staggered.

f. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

g. Keep insulation materials dry during application and finishing.

h. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

i. Install insulation with least number of joints practical.

j. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1) Install insulation continuously through hangers and around anchor attachments.

2) For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.

3) Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

4) Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

k. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

l. Install insulation with factory-applied jackets as follows:

1) Draw jacket tight and smooth.

2) Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.

3) Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.

4) Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.

5) Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.

m. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

n. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

o. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

5. General insulation installation requirements on fittings, valves, strainers, flanges, unions, and instrumentation.

a. Zeston plenum rated covers over 1 pound density microlite blanket and 18 gauge galvanized wire at all fittings.

b. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.

c. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids,

and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.

d. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.

e. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.

f. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover.

g. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.

h. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.

i. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

j. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

6. Mineral-fiber insulation installation requirements.

a. Insulation Installation on Straight Pipes and Tubes:

1) Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.

2) Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.

3) For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.

4) For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

b. Insulation Installation on Pipe Flanges:

1) Install preformed pipe insulation to outer diameter of pipe flange.

2) Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3) Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.

4) Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

c. Insulation Installation on Pipe Fittings and Elbows:

1) Install preformed sections of same material as straight segments of pipe insulation when available.

2) When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

d. Insulation Installation on Valves and Pipe Specialties:

1) Install preformed sections of same material as straight segments of pipe insulation when available.

2) When preformed sections are not available, install mitered sections of pipe insulation to valve body.

3) Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

4) Install insulation to flanges as specified for flange insulation application.

7. Insulation installation requirements at penetrations.

a. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

b. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.

1) Comply with requirements in Division 7 Section "Through-Penetration Firestop Systems" for firestopping and fire-resistive joint sealers.

8. Piping insulation schedule.

a. Insulation thickness must match values below at minimum and be increased to code required values if different than that stated.

1) Cold water process piping (1-1/2” diameter and larger): Mineral-Fiber, Preformed Pipe Insulation with ASJ, Type I: 1 inch thick.

2) Warm water process piping (1-1/2” diameter and larger): Mineral-Fiber, Preformed Pipe Insulation with ASJ, Type I: 1-1/2 inch thick.

E. Valves.

1. To the greatest extent possible, valves shall be installed at convenient locations for service and operation. The operating handle or wheel shall also be installed in the most convenient configuration available for service and operation.
2. All valves shall be tagged with unique tag colors for each system and unique identification. Valves shall be identified by their tag color and number within the operations and maintenance manual and any piping flow diagrams.

F. Y-Strainers.

1. Install Y-strainers per manufacturer's recommendations.
2. Y-Strainers to be installed in a horizontal pipe.

G. Supports & hangers.

1. Supports shall be provided at appropriate spacing intervals in accordance with manufacturer's recommendations.
    a. Support location and spacing depends on the pipe diameter, system operating temperature, and the location of any concentrated stress loads (valves, flanges, system components, etc.).
    b. Contractor is responsible for ensuring that adequate supports are provided.
    c. Contractor shall verify load capacity of walls, structural members, ceilings, etc. utilized for anchoring of supports and hangers with the General Contractor or Engineer prior to installation.
2. Overhead piping and supports must be installed to provide a minimum clearance of seven and one- half (7 ½) feet above the finished floor surface in all accessible areas.
3. Hangers must have an adequate load-bearing surface free of any rough or sharp edges that could damage the pipe during use.
4. Hangers must not restrict linear movement of the system in order to allow thermal expansion and contraction from temperature changes.
5. Field cut ends of all galvanized or zinc coated pipe support material shall be treated with a spray-on cold galvanizing compound.
6. Stainless steel or FRP supports and hardware must be used inside of all surge tanks and other wetted areas.

H. Pipe penetration seals and sleeves.

1. Link-Seals and Century-Line sleeves shall be used at all piping penetrations in foundation walls, interior building walls, and surge tanks (for piping penetrations that are not pre-established and will not be installed prior to concrete wall construction).
2. For conditions where piping can be installed prior to installation of the concrete wall, one of the following shall be utilized:
    a. Non-swelling SF302 Synko-Flex, or equal.
    b. Solvent welded PVC flange type waterstop.
3. Provide sleeves in accordance with manufacturer's recommended sizing (to be installed during concrete wall construction).
4. Select appropriate Link-Seal size per manufacturer's recommendations.
5. Follow manufacturer's installation instructions.

END OF SECTION

SECTION 13 11 46
SWIMMING POOL EQUIPMENT & ACCESSORIES

PART 1 GENERAL

1.01 SUMMARY

A. This section includes equipment and accessories for pools.

B. Products furnished under this section:

1. Deck equipment.
2. Health, life, and safety equipment.
3. Pool process fittings.
4. Pool process equipment.
5. Pool competition equipment.
6. Pool accessory features and equipment.
7. Surge tank equipment.
8. Maintenance and cleaning equipment.
9. ADA accessibility equipment.

C. Related Documents

1. Section 13 11 13.

1.02 REFERENCES

A. Reference Standards

1. The work in this section is subject to the requirements of applicable portions of the following standards:
    a. National Sanitation Foundation (NSF) International Standard 50 – Circulation System Components and Related Materials for Swimming Pools, Spas/Hot Tubs.
    b. Hydraulic Institute Standards.
    c. IEEE Standards.
    d. NEMA Standards.
    e. Underwriters Laboratories (UL).
    f. National Fire Protection Association (NFPA) 70 – National Electric Code.
    g. ASTM C1028 – Standard Test Method for Determining the Static Coefficient of Friction or Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method.
    h. ASTM G154 – Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials.
    i. Utah Code R392-302: Design, Construction, and Operation of Public Pools (Current Revision)
    j. Salt Lake Valley Health Department Health Regulation #2: Design, Construction, and Operation of Pools Regulation (Current Revision)

k. 2010 ADA Standards for Accessible Design.

l. Virginia Graeme Baker Pool and Spa Safety Act (VGBA ANSI/APSP/ICC-16 2017).

m. OSHA Rules and Regulations.

1.03 SUBMITTALS

A. Submit manufacturer's product data, certification data, and installation instructions for all items within the pool equipment lists.

1. Organize submittals into sections, one for each water body and one for general equipment.

a. The equipment for each water body (or section) shall be numbered and organized in identical order to the equipment lists contained within the Drawings.

2. Pump Curve Submittal

a. The manufacturer pump curve shall be included with each submittal indicating the pump design operating point.

1.04 QUALITY ASSURANCE

A. Qualifications

1. Horizontal Close Coupled End Suction Centrifugal Pumps

a. To assure a properly integrated and compatible system, all equipment shall be furnished by the pump manufacturer, who shall assume full responsibility for the proper operation of the pumps and associated equipment.

2. High-Rate Sand Filters

a. The equipment described herein shall be supplied by a manufacturer regularly engaged in the fabrication of commercial aquatic pressure vessel filtration systems for at least fifteen (15) years.

b. All equipment described herein shall be supplied by the same manufacturer to ensure that each item is properly sized to perform in conjunction with each other.

c. The installer of the equipment described herein shall have a minimum (5) years of operating history working on similar commercial aquatic projects.

3. Regenerative Media Filters

a. The equipment described herein shall be products of a manufacturer regularly engaged in the fabrication of filtration and recirculation systems for at least five (5) years.

b. All equipment described herein shall be supplied by the same manufacturer to ensure that each item is properly sized to perform in conjunction with each other.

c. The installer of the equipment described herein shall have a minimum of five (5) years of operating history working on similar commercial aquatic projects.

d. Provide a manufacturer's representative who shall be present at all times during the execution of this portion of the Work and who shall be thoroughly familiar with the materials and methods specified, and who shall direct all Work performed under this Section.

e. As assurance that each item of apparatus is properly sized to perform in conjunction with each other, all components of the regenerative media filtration

system shall be supplied by a filter manufacturer as listed and described herewith. Acceptable regenerative media equipment suppliers are:

Neptune-Benson | 334 Knight Street Suite 3100 Warwick, RI 02886 USA
+1 (800) 832-8002 | +1 (401) 821-2200 | www.evoqua.com

Aqua Revival | 4520 County Road F, Delavan, WI 53115
Mail: PO Box 796, Williams Bay, WI 53191
+1 (262) 725-6081 | www.aqua-revival.com

B. All equipment within the recirculation and accessory systems shall be certified to NSF Standard 50 (as applicable).

1. Documentation shall be submitted as requested.
2. Filters shall bear a label complete with NSF certification number.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Refer to requirements in Section 13 11 13.

1.06 WARRANTY

A. Refer to requirements in Section 13 11 13.

PART 2 PRODUCTS

2.01 EQUIPMENT LISTS

A. Supply and install all equipment as indicated within the equipment lists contained within the Drawings. Equipment indicated may not be inclusive of all equipment required. Pool Contractor is responsible for providing all equipment that is required for construction of a fully operational pool with accessories as indicated within the manufacturer's literature and the Project Documents. If an item of equipment is required for operation of the pools, that item shall be deemed to be included.

B. Product manufacturers and model numbers for equipment are listed to set a level of quality for each item specified. Substitutions may be allowed at the discretion of the Engineer in consultation with the Owner. The Engineer shall be the sole judge of whether equipment submitted meets or exceeds specified equipment. Requests for substitution shall be submitted in accordance with the requirements of Division 01 33 00.

1. If using alternate manufacturers, it is the responsibility of the Contractor to meet or exceed the specified equipment and make all modifications required to accommodate the substituted item.

2.02 DECK EQUIPMENT

A. Handrails

1. All handrails shall be three (3) or four (4) bend stair rails as manufactured by S.R. Smith, Spectrum Products, or equal.
   a. Handrails shall be fabricated of 1.50" O.D. x 0.120" wall thickness, 304 stainless steel.
   b. Handrails bends shall be wrinkle free.
   c. Handrails shall have a baked powder coat finish that includes a primer, base coat, and clear coat finish. The powder coat system shall have a minimum total thickness of 5 mil over the entire exterior surface of the rail. Color to be similar to brushed stainless steel, equal to S.R. Smith "Silver Gray" RAL 7038.

d. Handrails shall be manufactured to conform to setbacks, lengths, and stair slopes as indicated within the Drawings.

e. Handrails shall comply with the 2010 ADA Standards for Accessible Design.

B. Grab rails

1. All grab rails shall be Pretzel style as manufactured by S.R. Smith, Spectrum Products, or equal.

a. The grab rail setback shall be as indicated within the Drawings.

b. The grab rail shall be fabricated of 1.50" O.D. x 0.0.65" wall thickness, 304 stainless steel.

c. Grab rails shall be manufactured to dimensions as indicated within the Drawings.

d. The grab rail shall have bends that are wrinkle free.

e. The grab rail shall be supported by four (4) anchors.

f. Grab rails shall have a baked powder coat finish that includes a primer, base coat, and clear coat finish. The powder coat system shall have a minimum total thickness of 5 mil over the entire exterior surface of the rail. Color to be similar to brushed stainless steel, equal to S.R. Smith "Silver Gray" RAL 7038.

C. Recessed Molded Steps

1. Recessed molded steps as manufactured by S.R. Smith, Spectrum Products, or equal.

a. Steps shall be manufactured from heavy-duty injection molded plastic.

b. Steps shall be manufactured to dimensions as indicated within the Drawings.

c. Steps shall include a non-skid surface on the tread.

d. Step treads shall be sloped to drain towards the pool.

e. Color: White.

D. Anchors

1. All rails shall be anchored with 1.50" stainless steel wedge anchors as manufactured by S.R. Smith, Spectrum Aquatics, or equal.

a. The anchor shall be of the wedge type and shall be designed to support a 1.50" O.D. stainless steel rail. A wedge shoe shall be employed, applying pressure to the retained rail and providing support. Wedge anchor bodies incorporating brass or bronze material will not be allowed.

b. The anchor body shall be fabricated from 316 stainless steel. The body component of the anchor shall be cast, ensuring consistent strength, ductility, and resistance to impact and it shall incorporate provisions for anti-rotation. The anchor body shall be 6" deep and shall be 1.50" inside diameter, ± 0.02". Close tolerance dimensions shall ensure a secure fit for railings.

c. A cast brass (85-5-5-5) wedge shall be employed as the rail retainer. The wedge shall incorporate an 18-8-stainless steel 5/16-18-hexhead tightening bolt and flat washer. The wedge shall be designed as the sacrificial element to the anchor system, allowing for ease of repair and maintenance.

d. A bonding screw shall be installed on the lower portion of the anchor. The bonding screw will be 18-8-stainless steel and shall be not less than ¼" in diameter. The anchor shall be designed so that an escutcheon plate is not necessary.

e. Each anchor assembly shall include a round escutcheon plate matching the rail size. Escutcheon plates to be powder coated to match the rail finish.

E. Finish

1. All stainless-steel rails and escutcheon plates shall have a baked powder coat finish that includes a primer, base coat, and clear coat finish. The powder coat system shall have a minimum total thickness of 5 mil over the entire exterior surface of the rail. Color to be similar to brushed stainless steel, equal to S.R. Smith "Silver Gray" RAL 7038.

F. Trench Drains

1. All trench drains shall be linear modular trench drain systems model Z880 manufactured by Zurn Industries LLC, or equal.

a. Drain body material: High-density polyethylene that is UV-10 stabilized.

b. Module size: Segments that are 48" long, 2 ½" wide, and 3" deep.

c. Drains shall have bedding feet to be used for positioning and anchoring purposes.

d. Drains shall have tongue and groove snap fit connections.

e. Drains shall include outlet adapters as necessary for connection to plumbing drains.

f. Drains shall include 24" long high-density polyethylene decorative grates.

g. Grate color selection: Gray.

G. Backstroke Flag Support Cables

1. Support cables for backstroke stanchions shall be stainless steel wire cables by Continental Cable LLC, or equal.

a. Material: 316 stainless steel.

b. Diameter: ¼".

c. Breaking strength: 7650 lbs.

d. Temperature resistance: up to 900 deg F.

2. Cables shall include 316 stainless steel hardware for mounting to backstroke stanchion and backstroke flag eye rings.

2.03 HEALTH, LIFE, AND SAFETY EQUIPMENT

A. First aid equipment.

1. Supply the following equipment:

a. Rescue blanket shall be a wool blanket, minimum dimensions of 60" x 84", Item #10-606 as supplied by Kemp USA, or equal.

b. Rescue backboard, 78"x20", item CJ6, by C.J. Aquatics. Backboard shall include head immobilizer and straps.

1) The rescue backboard specified is prototypical for all new facilities constructed by the Owner. Substitutions will not be considered.

2. Pool Contractor shall verify that all equipment is in compliance with applicable jurisdictional requirements, that sufficient quantities are present, and that no other

equipment is required for final jurisdictional approval. The Engineer shall be notified if additional quantities or equipment are required.

B. Signage

1. Pool signage to be procured and installed by Owner.

C. Rope Anchors

1. All rope anchors shall be constructed of a non-metallic body with a stainless steel bar as manufactured by Pentair Water Pool and Spa, or equal.
    a. The size of the stainless-steel bar within the anchor shall be less than maximum size requirements per NEC for exclusion of required grounding.
    b. The cup and flange portion of the anchor body shall be stamped or drawn from a single piece of material.
    c. The cup portion shall be 3” inside diameter with a depth of 2.5”.
    d. The face flange shall be 4” square.

D. Stanchion posts.

1. All stanchion posts shall be stainless steel with an integral eye ring as manufactured by S.R. Smith, Spectrum Products, or equal.
    a. 8’-0” length
        1) The stanchion post shall be fabricated of 1.90” O.D. x 0.145” wall thickness 304 series stainless steel.
        2) The post shall be 96” in overall length.
        3) Posts shall have a baked powder coat finish that includes a primer, base coat, and clear coat finish. The powder coat system shall have a minimum total thickness of 5 mil over the entire exterior surface of the post. Color to be similar to brushed stainless steel, equal to S.R. Smith “Silver Gray” RAL 7038.
    b. All stanchion posts shall have a 2” ring MIG welded to their top surface.
    c. All stanchion posts shall be supported by one (1) 6” 316 stainless steel slip-type anchor as manufactured by S.R. Smith, or equal.
        1) The anchor shall be supplied by the same manufacturer as the stanchion post.
        2) The anchor shall come complete with a slip style stainless steel lid.

E. Lifeline rope and floats.

1. Rope shall be ¾” diameter pool rope.
    a. Rope shall be recommended for use in pools.
    b. Rope shall be made from a color-safe, strong, floating polypropylene.
    c. Supply chrome plated brass clamp-type rope hooks for all connections to cup anchors at pool wall.
    d. Color shall be blue and white.
2. Floats shall be Handi-Lock, 5-inch x 9 inch, or equal.
    a. Floats shall be recommended for use in pool.

b. Floats shall be made of linear polyethylene treated with chlorine inhibitors and UV stabilizers.

c. Floats shall be capable of locking onto the lifeline rope without attachments.

d. Floats shall have three sealed compartments for optimum buoyancy in case of puncture.

e. Color shall be blue and white.

F. Life hooks.

1. Life hook shall be “shepherd’s crook” style with fixed sixteen (16) foot pole as manufactured by Pentair, or equal.

a. Pole shall be constructed of fiberglass, aluminum, or stainless steel.

b. Life hook shape and dimensions shall be typical of standard industry designs.

c. Each life hook shall be supplied with two (2) stainless steel pole hangers as supplied by Pentair, or equal.

1) Mounting hardware shall be supplied by manufacturer.

d. Pool Contractor shall ensure that life hook supplied meets all jurisdictional requirements and is of sufficient quantity. Notify the Engineer if additional quantities or alternate equipment is required.

G. Ring buoys.

1. Ring buoys shall be twenty-four (24) inch diameter, United States Coast Guard approved, as supplied by Cal June, or equal.

a. Ring buoy shall be supplied complete with a minimum 3/16” diameter throw rope (length per individual vessel Equipment List in Drawings).

b. Throw rope.

1) Rope shall be recommended for use in pool.

2) Rope shall be made from a color-safe, strong, floating polypropylene.

3) Throw rope shall be coiled or bagged to preclude tangling during use.

c. Each ring buoy shall be supplied with one (1) stainless steel pole hanger as supplied by Pentair, or equal.

1) Mounting hardware shall be supplied by manufacturer.

d. Pool Contractor shall ensure that ring buoy supplied meets all jurisdictional requirements and is of sufficient quantity. Notify the Engineer if additional quantities or alternate equipment is required.

H. Lifeguard chairs.

1. Lifeguard chairs as manufactured by Tailwind Furniture.

a. Chairs and frames shall be constructed of recycled plastic with UV inhibitors and stainless steel hardware.

b. Chair steps shall have a non-skid surface.

c. Chairs shall have 60” seat height.

d. The lifeguard chair specified is prototypical for all new facilities constructed by the Owner. Substitutions will not be considered.

e. Color: White.

I. Underwater Lights

1. All underwater lights shall be IntelliBrite Architectural Series White LED as manufactured by Pentair Water Pool and Spa, or equal.

a. Underwater lights shall be LED. Incandescent lights will not be allowed.

b. Refer to equipment lists for required lumens and equivalent wattage sizes.

c. Light shall have tempered glass convex lens.

d. Furnish complete with stainless steel light niche and stainless-steel face ring. Coordinate cord length with Electrical Contractor.

J. Backwash Pit Grating

1. Backwash pit grating shall be Duragrid series I-4000 as manufactured by Strongwell, or equal

a. Grating shall be pultruded and assembled in the U.S.A.

b. Resin shall be fire retardant polyester meeting the requirements of a Class 1 rating of 25 or less per ASTM E84 and the self-extinguishing requirements of ASTM D635.

c. Bearing bar color shall be yellow.

d. Resin shall be UV inhibited and the composite shall include a veil on all exposed surfaces. Panels shall be assembled into the sizes ordering using a 3-piece pultruded cross-rod system with color correlating with chosen resin system: polyester = light gray, vinyl ester = black.

e. The cross-rods shall consist of a center core wedge and two spacer bars that are notched at each bearing bar so that each bearing bar is both mechanically locked and chemically bonded to the web of each bearing bar.

f. The spacer bars shall be continuously bonded to the center core wedge.

g. The cross-rods shall be spaced a maximum of 6” in the panel.

h. The top of the panels shall be covered with a bonded grit anti-skid surface.

2.04 POOL PROCESS FITTINGS

A. Skimmers

1. Skimmers shall be U-3 style as manufactured by Pentair Water Pool and Spa.

a. Skimmer shall include equalizer port and float valve.

b. Color: White.

c. The skimmer specified is prototypical for all new facilities constructed by the Owner. Substitutions will not be considered.

B. Main Drain Suction Chambers

1. Large area main drains and feature suction chambers shall be unblockable, 18”x36” PVC drain covers with fiberglass sumps as manufactured by AquaStar Pool Products, Lawson Aquatics, Daldorado, or equal.
    a. Drain covers shall be constructed of UV-stabilized PVC grating.
        1) Drain covers shall be ASME/ANSI A112.19.8 compliant.
        2) Drain covers shall contain all required stamps and/or labels indicating compliance with the Virginia Graeme Baker Pool and Spa Safety Act.
        3) Drain cover shall have minimum open area of 54%.
        4) Components must meet ASTM G154 standards, requiring finished products to withstand 750 hours UV exposure.
        5) The top surface must have a raised, non-slip pattern to meet the static coefficient of friction, while wet or dry, in accordance with ASTM C1028.
        6) Drain cover must meet or exceed ASTM E661, which states allowable deflection at 200 lbs. and load to failure criteria.
    b. The main drains and feature suction drain covers shall be installed within a fiberglass sump supplied by the manufacturer and certified for use with the drain.
        1) Sump shall be custom manufactured for plumbing connections required.
        2) Sump shall be fabricated using fiberglass mat, marine quality resin and colored gel coat. The gel coat is only applied to the inside of the sump.
        3) Wall thickness of 0.19”.
        4) 2” FRP waterstop glassed onto sump.
    c. Color: White.
2. Strip style main drain suction chambers shall be unblockable, 4x32” PVC drain covers with PVC sumps as manufactured by AquaStar Pool Products, or equal.
    a. Drain covers shall be constructed of UV-stabilized PVC grating.
        1) Drain covers shall be ASME/ANSI A112.19.8 compliant.
        2) Drain covers shall contain all required stamps and/or labels indicating compliance with the Virginia Graeme Baker Pool and Spa Safety Act.
        3) Drain cover shall have minimum open area of 24 square inches.
        4) Drain cover shall not protrude beyond finished surface of pool by more than 1/8”
    b. Color: White.

C. Hydrostatic Relief Valve and Collector tube
1. Hydrostatic relief valve and collector tube as manufactured by Hayward, or equal.
    a. Hydrostatic relief valve shall be white ABS, spring loaded, with a leak proof self-cleaning O-ring seal, non-corrosive, and non-conductive.
    b. Hydrostatic relief valve collector tube shall be white ABS, with a minimum length of 12”.

D. Inlets
1. Directional wall inlets as manufactured by Pentair Water Pool and Spa, or equal.

a. 1 ½" threaded directional eyeballs with snap in disks.

b. Interchangeable with ½", ¾", and 1" orifices.

c. Furnish orifice size as specified within the pool equipment list.

d. Color: White.

2. Floor inlets as manufactured by Pentair Water Pool and Spa, or equal.

a. Adjustable flow rate.

b. Fully closeable for winterizing.

c. Color: White.

2.05 POOL PROCESS EQUIPMENT

A. Gauges

1. Pressure and compound gauges shall be 4" liquid filled with stainless steel bayonet ring and cases as manufactured by Weiss Instruments, Inc., or equal.

a. Case and Ring: 4" type 304 stainless steel case with polished stainless steel bayonet ring.

b. Dial: White aluminum with black and red markings.

c. Window: Clear acrylic.

d. Tube: Phosphor bronze.

e. Socket: Brass with push-in restrictor.

f. Pointer: Black anodized aluminum, adjustable.

g. Movement: Brass rotary type with bushings.

h. Accuracy: 1% of gauge range.

i. Connection: ¼" NPT bottom.

j. Ranges: Vacuum, compound, pressure to 15,000 psi.

k. Gauge shall be supplied complete with petcock and snubber.

B. Strainer

1. The Project Documents have been prepared utilizing equipment manufactured by Fluidtrol Process Technologies, Inc. Huntsville, AL as the basis of design.

2. Neptune Benson and Mer-Made are pre-approved equals for strainers.

3. Additional equals may be approved at the sole discretion of the Owner and Engineer.

4. The strainer system shall consist of a strainer body, a strainer lid, and a strainer basket. (Furnish spare strainer basket for every system).

a. Each strainer shall come with a cover plate or lid with clear viewing window, gasket seal, hinged sealing hardware, two (2) stainless steel strainer baskets, drain and vent plugs.

b. The hair and lint strainer shall be fabricated of Fiberglass Reinforced Plastic (FRP).

c. The strainer shall be designed for a maximum operating pressure of 50 PSIG and a normal vacuum service of 14" of mercury, with a hydrostatic test pressure of 50 PSIG.

d. The strainer system shall be installed with one influent PVC Vanstone flange and one effluent PVC Vanstone flange for horizontal connections.

e. Unit shall include hinged securing assemblies to permit easy opening and closing of strainer lid without the use of tools.

f. Basket shall self-center and remove in one simple motion.

g. Basket shall provide a positive seal at the basket flange.

h. The strainer lid shall be sealed to the body through the use of a food grade EPDM ring.

i. The body and lid shall have PVC plugs complete with O-ring seals for draining and venting of the strainer.

j. Exterior shall have UV protective inhibitors to maximize service life.

k. The strainer basket shall be manufactured with 316 stainless steel.

1) Open area of basket shall be no less than 4 times greater than the influent connection.

5. All strainers shall be eccentric reducing.

C. Self-Priming Centrifugal Pumps

1. Self-Priming Pumps 5 hp. and larger shall be EQ Series models as identified on the drawings manufactured by Pentair Water Pool and Spa.

a. Pump shall include integral strainer with “see thru” lid.

b. Pump shall be self-priming.

c. Motor shall be premium efficient, totally enclosed fan cooled (TEFC) JMZ frame.

d. Pump body shall be constructed of robust thermoplastic heavy-duty durable materials.

e. Pump shall be designed for use in commercial applications and shall be listed and labeled to NSF 50 standard by an ANSI accredited certification organization.

f. Pump shall be supplied with a spare strainer basket.

2. Self-priming Pumps 5 hp. and smaller shall be WhisperFlo XF VS models as identified on the drawings manufactured by Pentair Water Pool and Spa.

a. Pump shall include integral strainer with “see thru” lid.

b. Pump shall be self-priming.

c. Motor shall include threaded shaft and durable commercial duty 56 frame motor with NEMA square flange.

d. Pump body shall be constructed of robust thermoplastic heavy-duty durable materials.

e. Pump shall have an integrated motor/drive.

f. Pump utilizing a 4-20mA flow meter shall be provided with a digital input wiring kit.

g. Pump shall be designed for use in commercial applications and shall be listed and labeled to NSF 50 standard by an ANSI accredited certification organization.

h. Pump shall be supplied with a spare strainer basket.

D. Pool Pump Variable Frequency Drive (VFD)

1. Furnish complete VFD as specified herein and in the equipment schedule for loads designated to be variable speed. Basis of design is the Acu-Drive XS by Pentair Water Pool and Spa. VFD's by Danfoss or Neptune Benson may be considered as equals.

2. Protective Features:

a. The VFD shall have input surge protection to withstand surges of 2.3 times line voltage for 1.3 msec.

b. End-of Pump curve detection shall stop motor when the pump is operating outside of its programmed pump curve.

c. The VFD shall provide flow compensation to reduce energy by adjusting the set point to match changes in flow.

d. The VFD shall include current sensors on all three-output phases to detect and report phase loss to the motor.

3. Interface Features:

a. The VFD shall provide an alphanumeric backlit display keypad. The VFD shall have the ability to display five different parameters about the VFD or load including: current, speed, DC bus voltage, output voltage, input signal in mA or other values from a list of different parameters.

b. The VFD shall include a Hand-Off-Auto disconnect switch on the face of the panel.

c. A red FAULT light, a yellow WARNING light, and a green POWER-ON light shall be provided.

d. Two level password protection shall be provided to prevent changes to the programming of the VFD.

e. The VFD shall include an internal clock that can be used for: timed actions, energy meter, trend analysis, date/time stamps on alarms, logged data, preventative maintenance, or other uses.

f. There shall be six fully programmable digital inputs for interfacing with the system's external control and safety interlock circuitry. Two of these inputs shall be programmable as inputs or outputs.

g. The VFD shall have two analog signal inputs. Inputs shall be programmable for either 0-10V or 0/4-20mA.

h. The VFD shall be equipped with a standard RS-485 serial communications port and a front of drive accessible USB port.

4. Adjustments:

a. The VFD shall have an adjustable output switching frequency.

b. The VFD shall have four programmable "skip frequencies" with adjustable bandwidths to prevent the driven equipment from running at a mechanically resonant frequency.

c. The VFD shall include an automatic acceleration and deceleration ramp-time function to prevent nuisance tripping and simplify start-up.

d. The VFD will include a user selectable Reset function which enables the selection of between 0 and 20 restart attempts after any self-clearing fault condition (undervoltage, overvoltage, current limit, inverter overload, and motor overload).

e. The VFD will include a user-selectable Auto-Restart function that enables the VFD to power up in a running condition after power loss to prevent the need to manually reset and restart the VFD.

5. Service Conditions:

a. Ambient temperature to be 14 ^{O}F to 113 ^{O}F.

b. Relative humidity 0 to 95%.

c. Elevation to 3,300 feet without derating.

d. VFDs shall be rated for line voltage of 525 to 690 VAC, 380 to 480 VAC, or 200 to 240 VAC with +10% to -15% variation.

e. Line frequency variation of +2% shall be acceptable.

f. No side clearance shall be required for cooling of the units.

6. The VFD and all required options shall be incorporated by the VFD manufacturer into an integrated package, with a single input feed and main disconnect. All enclosures shall be UL listed and labeled to meet the requirements of UL-508C. The unit shall be assembled by the VFD manufacturer in an ISO 9001 registered facility and completed tested by the manufacturer.

E. Sand Filtration Systems

1. Manufacturers

a. The filter system specified under this section shall be a pressurized Hi-Rate Permanent Media Filter design as manufactured by Neptune Benson, Pentair, Fluidra USA, or equal. Neptune Benson is the basis of design. Equipment by other manufacturers must fit within the footprint shown on the drawings.

2. Filter Area

a. The total effective filtration area of each tank shall be provided in accordance with the design requirements found within the Drawings.

3. Description

a. The filter system shall be listed and labeled for swimming pool/spa use to NSF/ANSI Standard 50 by an ANSI accredited certification organization. The filter certification shall be for a maximum flow of 20 gallons per minute per square foot of filter area.

b. The filter tank system shall consist of filter tank(s) as shown on the drawings, internal distribution system, internal air vent, manway opening/ cover, external vent and drain assembly. The tank(s) shall be manufactured in a fully assembled state with the external air vent disassembled for shipping. The filter(s) shall be designed and manufactured in a manner to allow for shipping under normal conditions without internal damage to the filter.

c. Filter Tanks

1) The filter tank(s) shall be constructed of fiberglass resin with a maximum working pressure of 50 psi, hydrostatically tested to 1.1 x maximum working pressure and designed to a minimum of 4:1 safety factor.

2) Each filter tank(s) shall consist of a body and two dished heads manufactured with a dual wall structure consisting of a contact molded inner structure and a filament wound outer structure. The inner structure shall be manufactured with Woven Roving and Chop Strand Mat on a male mold in a two or three-piece design, depending on length, and joined together with secondary joint(s) before applying the outer structure. The outer structure shall be filament wound in both radial and axial geometric patterns to provide maximum strength in all load directions. The dished heads and body thicknesses shall be designed according to ASME Section X requirements confirmed through calculations and a Finite Element Stress Analysis. The outer structure of the tanks shall be seamless and constructed of pigmented resin to provide a professional exterior finish.

3) Horizontal filter tank(s) shall be mounted on two FRP saddle supports that are permanently bonded to the tank through the use of a structural adhesive system. Stacked tank configurations shall include saddles on top of the bottom tank to accommodate stacking of the top tank. The tank support saddles shall be designed in compliance to all relevant seismic code requirements when anchored to the manufacturer's specifications.

4) Vertical filter tank(s) shall be mounted on a circular base that is permanently bonded to the tank. The tank support base shall be designed in compliance to all relevant seismic code requirements when anchored to the manufacturer's specifications.

5) A 16" round flanged manhole complete with FRP cover, O-ring-gasket and bolts shall be located in the body of the filter tank(s). All O-ring-gasket contact points on the manhole flange and cover shall have a smooth finish to provide a continuous watertight seal.

6) A 2'' combination media dump port and drain complete with an ABS media retainer and flange type closure shall be located in the side shell of the filter tank(s).

7) A ¾" external air relief complete with PVC ball valve shall be located in the side shell of the filter tank(s).

8) The influent and effluent ports shall be flanged to facilitate proper connection of both internal and external piping. The influent/ effluent ports shall consist of FRP flanges designed according to ASTM-PS 15-69-NBS with an ANSI standard 150 lb. bolt pattern.

d. Internal Distribution and Collection System

1) The filter tank equipment shall include an upper distribution system and lower collection system, hydraulically balanced to prevent filter media migration during filter operation and/ or backwash.

2) The upper distribution system shall include hydraulic diffusers manufactured of injection molded PVC plastic, located in multiple sets of two over the filter bed. They shall be piped to a Schedule 80 PVC distribution header with

Schedule 80 PVC pipe and fittings appropriately sized to maintain proper flow velocities throughout the entire distribution system.

3) The lower collection system shall consist of a Schedule 80 PVC header and molded ABS plastic laterals with .009" tapered slots designed to retain a single grade of filter media with .23 mm particle size. The internal collection system shall be designed to promote media bed circulation during backwash while providing minimal head loss during filtration.

e. Filter Media

1) Filter media shall be Vitro Clean Aquatic crushed glass filtration media as manufactured by TriVitro Corp. and standard pea gravel.

2) Vitro Clean Aquatic

(a) Crushed glass filtration media.

(b) Specific Gravity: 2.50

(c) Bulk Density: 75-80 pounds per cubic foot.

(d) Effect Size: Ranges from 0.30 to 1.10 mm

(e) Coefficient of Uniformity: 1.45-1.80.

(f) Shape: Angular to sub-angular.

(g) Physical Composition: Amorphous soda-lime glass.

3) Pea Gravel

(a) Filter media bed.

(b) Specific Gravity: not less than 2.50.

(c) Particle Size: 1/8" x 1/4".

(d) Shape: sub-angular.

(e) Physical Composition: shall be free from minerals which may precipitate onto pool surfaces.

4) Filter media shall be NSF approved.

5) Install media quantities and depths in accordance with manufacturer's instructions.

6) Filters shall contain pea gravel in the bottom of the filter up to the top of the lower laterals, approximately 25% of the total filter media by volume.

f. Pressure Gauge Panel

1) Systems utilizing prefabricated face piping shall include a pressure gauge panel.

(a) The pressure gauge panel shall consist of two 4½" diameter gauges scaled from 0-100 PSIG. The pressure gauges shall be mounted in an injection molded panel. The pressure gauges shall be connected to influent and effluent pressure points with air relief cocks, compression fittings and semi-rigid PVC tubing.

(b) Systems utilizing dual filters shall include an individual pressure gauge panel for each filter. Two (2) total connected as required for individual filter readings.

2) Systems utilizing field-fabricated face piping shall include a pressure gauge on the filter influent and the filter effluent piping.

g. Air Relief Valve.

1) All models shall be furnished with a snubber, piping, and valves for manual and automatic means of air release.

2) Operation instructions shall be permanently installed on the filter that include a warning statement not to start up the system after maintenance without first opening the air release and properly reassembling the filter and separation tank. This statement shall be readily visible from the area of the air release and the start-up controls.

h. Drain/Media Dump Port

1) All models shall include drain and media dump ports.

2) Drain out system shall consist of integrally molded fitting at the tank bottom with an ABS media retainer.

i. Data plate

1) Filtration system shall include a data plate in a conspicuous location that includes at minimum the following information: manufacturer name and address, filter model #, filter serial #, effective filtration area in s.f., filtration and backwash design flow rate in U.S. gallons per minute (specific to project/water body), maximum working pressure, and filtration rate (specific to each water body).

j. Prefabricated Face Piping

1) Where specified on the pool equipment list, face piping must be supplied by the same manufacturer as the filter tank and shall be pre-assembled by the manufacturer.

2) Valves shall comply with the requirements of Section 13 11 16.

3) The face piping shall be designed for a maximum working pressure of 50 psi.

4) The face piping shall include integral PVC Vanstone mating flanges for connection to the filter tank and field connected piping.

5) The face piping shall be fabricated in a fully assembled state by the filter manufacturer of Schedule 80 PVC pipe and fittings. Flanges shall be located to allow for easy disassembly to prevent damage during shipping.

6) The butterfly valves shall be constructed of PVC with aluminum handles. The valve shall have EPDM and PE that provide shut off up to 150 psi while sealing the valve stem from exposure to internal liquids. The face piping shall be certified by NSF International as an operational component for the filter system carrying the same pressure and flow ratings as the filter tank.

7) Face piping shall be furnished with a single-lever linkage to permit easy operation of the filter and transfer between operational modes (filtration and backwash). The operation valves, influent, effluent, backwash by-pass and backwash ports shall all be marked with identification labeling.

(a) A clevis and rod linkage system shall connect the butterfly valves furnished with the face piping. Simplified operation shall be achieved through the raising or lowering of a single operating handle.

(b) Connecting components shall vary in length to provide suitable mechanical advantage to operate the system. All valves shall operate simultaneously to eliminate the possibility of water hammer. The linkage components shall be constructed of T304 stainless steel designed to allow for individual valve adjustment to ensure proper positioning of the valves.

8) Single-lever linkage and connections shall be stainless steel. Shoulder bolts and Teflon bushings shall be used at every moving joint of the linkage. Valves shall be set to move concurrently, with one opening while the other is closing. Each valve shall be adjustable to provide for accurate positioning and tight shut off. The linkage shall have a locking pin to secure the valves in the filter position and to act as a locator for the backwash position.

F. Regenerative Media Filtration Systems

1. Manufacturers

a. The filter system specified under this section shall be a Regenerative Media Filter design as manufactured by Neptune Benson, Aqua Revival, or equal. Equipment by other manufacturers must fit within the footprint shown on the drawings.

2. Filter Area

a. The total effective filtration area of each tank shall be provided in accordance with the design requirements found within the Drawings.

3. Description

a. The filter system shall be listed and labeled for swimming pool/spa use to NSF/ANSI Standard 50 by an ANSI accredited certification organization.

b. Filter System

1) The primary components of the system shall consist of filter tank(s) as shown on the drawings, flexible tube filter elements, element assembly, media regeneration system, vacuum transfer system, precoat valves, sight glass, pressure gauges and system controller.

c. Filter System Capacity

1) The filter system shall consist of one filter tank per pool capable of meeting the design parameters shown in the pool data table in the Drawings

2) Filtration area shall be provided as specified and as certified to NSF Standard-50 to provide the specific filter rate. No modifications, manipulation or interpretation of these values shall be permitted.

3) The filter system shall be designed to maximize square footage of filter area while minimizing operating weight.

d. Filter Tank Construction

1) Carbon Steel Tanks

(a) Tank construction

(1) The filter tanks shall have a 60-inch side shell, suitable for 50 psi working pressure and hydrostatically tested to 75 psi.

(2) The tank shell shall be not less than ¼" thick.

(3) Bottom dished head shall be not less than ¼" thick.

(4) Top flat head shall be not less than 1 ½" thick.

(5) All material shall be Type A-36 carbon steel.

(6) All welding shall be performed by qualified operators. Joints shall be butt or fillet welded inside and out by manual or automatic process. Welded joints shall have complete penetration and fusion with little or no reduction of the thickness of the base metal. Welds shall be free of coarse ripples, grooves, overlaps, abrupt ridges, or valleys. All welded surfaces shall be chipped and brushed clean, when necessary, leaving no slag or splatter.

(7) Tank legs shall be constructed of 6" x 2 ½" channel legs ¼" thick. All 24", 27" and 33" filters shall have three (3) legs. All 41", 49" and 55" filters shall have four (4) legs. The material shall be Type A-36 carbon steel. Bearing plates shall be 10" x 5" x ½" type 304L stainless steel. Each bearing plate shall have two (2) 5/8" drilled holes to secure to the floor with ½" x 4 ½" stainless steel concrete anchors furnished. The legs shall be designed with bolted connections to minimize overall tank height for shipping and access into the mechanical room.

(8) The tank head shall be bolted to the shell with 7/8" diameter T304 stainless steel bolts, nuts, and washers, 9" on center around the tank perimeter.

(9) The tank shall be equipped with a UL listed grounding lug.

(10) The tank shall include a 12" diameter access port with cover, 6" viewing window, hardware to facilitate cleaning of tube elements and interior inspection of the filter and lift gland.

(11) The tank shall include brackets for mounting of the system controller, gauge panel, filter/regulator, vacuum blower, and vacuum hose rack.

(12) The tank shall include an integrally mounted hydraulic lifting device (davit). The davit assembly shall be designed to rotate 180-degrees for access to the tube sheet.

(b) Flexsol 3000 Interior Lining

(1) All interior surfaces shall be grit blasted to white metal condition with a 2-3 mil profile. Blasted surfaces shall be cleaned of all dust or blast residue. Lining shall be applied as soon as is practical on the same day blasting is done.

(2) Flexsol 3000 shall be a urethane, 100-percent solid plural component lining. Hardness shall be 75 durometer on the Shore D scale. Break tensile strength shall be 4,000 psi with elongation of less than 10-percent. Adhesion shall be greater than 2,500 psi.

(3) Application of Flexsol 3000 lining shall be done by experienced applicators using a high pressure, high temperature plural component system. All wetted surfaces including flange faces, manway rings and manway covers shall be lined to 100 mils +/- 10 mils WFT.

(4) Hardness shall be verified after curing to ASTM D 2240 standard.

(5) Manufacturer shall submit for approval a sample piece of coated steel to determine flexibility, abrasion tolerance and adhesion integrity.

(6) Flexsol 3000 linin shall meet the NSF toxicity standard unconditionally and shall be approved for use with the NSF approved filter.

(7) Flexsol 3000 lined vessels shall carry a ten (10) year limited non-prorated warranty.

(8) The filter manufacturer shall bear the responsibility for suitability of lining and shall be the sole source for the specified warranty.

(c) Exterior Coatings

(1) All exterior surfaces shall be grit blasted to white metal condition with a 2-3 mil profile. Blasted surfaces shall be cleaned of all dust or blast residue.

(2) Two coats of high solids enamel shall be applied for a total developed film thickness of 5-8 mils.

(3) Manufacturer shall supply minimum 16 oz of high solids enamel touch-up paint.

2) Stainless Steel Tanks

(a) Tank Construction

(1) The filter tanks shall have a side shell less than or equal to 50 inches tall, ASME Code stamped for 50 psi working pressure and hydrostatically tester per ASME Code Section VIII. All material shall be Type 304L or dual rated 304/304L stainless steel.

(2) All welding shall be performed by certified Code welders. All welds to be neat in appearance, free from slag and other defects, ground and polished to minimum 63 RMS. All stainless-steel tanks must be passivated post hydrostatic test.

(3) All tanks must have four (4) legs. Tank legs shall be constructed of 304/304L stainless steel. Bearing plates shall be a minimum ¼” type 304/304L stainless steel. Each bearing plate shall have one (1) 5/8” drilled holes to secure to the floor with the ½” x 4-1/2” stainless steel concrete anchors furnished. For systems installed onto steel deck equipment platforms, filters shall be bolted, not welded to the equipment platform deck.

(4) The tank cover flange shall be bolted to the shell flange with ASME Section VIII approved hardware. Filters that do not incorporate full tank cover flanges shall not be considered.

(5) The tank shall incorporate ASME viewing window (sight glass).

(6) The tank shall include brackets for mounting of the system controller, unless specified for wall mounting.

e. Internal Components

1) The filter shall consist of flexible tube elements, filter tube sheet and internal flow diversion assembly.

2) Filter elements shall be flexible tubes that provide support for the media. The outer wall of each filter element shall be fabricated of multi-filament high strength polyester braid. Each element shall have an internal T316 stainless steel spring, which acts as a support structure for the braided filament.

3) The filter element tube sheet shall be fabricated of PVC or 304L stainless steel and provide both support for the top of the element assembly as well as the watertight seal.

4) All stainless-steel wetted fasteners shall be Type 316.

f. Filter Tank Connections

1) Each filter tank shall be equipped with necessary flanges and connections for internal and external piping. Connections shall be comprised of 1” minimum thickness fiberglass flanges with ANSI class 150 standard bolt pattern. Connections requiring bolt-thru hardware will not be accepted.

2) The filter tank shall incorporate flanged connections for filter influent and filter effluent.

3) The filter tank shall incorporate connections for drain and vacuum transfer piping.

4) The filter tank drain-out system shall consist of a single elbow integral to the tank bottom head.

g. Media regeneration system

1) System shall include the manufacturers standard media regeneration system.

h. Filter System Controller

1) The control panel shall allow the user to initiate a completely automatic media regeneration sequence.

2) The filter system controller shall be provided by the filter manufacturer.

i. Vacuum Transfer System

1) A vacuum transfer system shall be furnished to allow the recharging of media into the filter for either bag or bulk media.

2) The manufacturer shall furnish all necessary pipe, fittings, and hardware for field plumbing of the vacuum transfer system.

j. System Valves

1) Each filter shall include system valves to facilitate system fill after media recharge, precoat/regeneration, influent and effluent for filtering and media dump/drain valve.

2) The precoat/regeneration and effluent valves shall be butterfly type with pneumatic actuators.

k. Valves

1) Valves shall be butterfly valves and shall be installed for influent, effluent, precoat and media regeneration system valves.

l. Pneumatic Actuators

1) Each filter shall include pneumatic actuators for one (1) effluent valve, one (1) precoat valve and three (3) media regeneration valves.

2) Actuators shall be double acting with valve mounted drilling to ISO 5211.

3) The actuators shall include two (2) 1/8” or 1/4” FPT ports for open/close connections. Flow control valve with quick connect fitting shall be installed at each port to allow speed control adjustment for the open/close function of the actuators.

m. Air Compressor

1) The filter system will require one (1) air compressor per mechanical room as recommended to meet the filter manufacturer’s specifications.

n. Filter Media

1) Media shall be expanded perlite with a median particle size of 37 microns. Percentage retained on a +150 Tyler Mesh shall not be less than 8% or more than 25%. Darcy permeability shall be between 1.2-1.85.

2) The media shall contain no more than one-tenth of one percent (0.001) of crystalline silicate.

3) The media shall be certified by the Manufacture for use in the filters. The media shall be NSF Standard-50 listed.

o. Media Separation

1) Media separation shall be furnished as specified in the Drawings.

p. Filter Cleaner

1) Each filter system shall be furnished with one (1) charge of chemical for cleaning and degreasing of filter tube elements.

q. Warranties

1) Provide manufacturer’s standard warranties.

G. Automated Chemical Controllers

1. Automated chemical controllers for Indoor Pools and Spas shall be the THOR L800 or L400 Digital Controller, as manufactured by Energy Resource Products, LLC, and shall include sensors for pH, ORP, temperature, and free chlorine (non-stabilized water). Automated chemical controllers for Outdoor Pools and Spas shall be the THOR L800 or L400, as manufactured by Energy Resource Products, LLC, and shall include sensors for pH, ORP, temperature, and total chlorine (stabilized water). Additional conductivity sensors shall be included with chemical controllers for spas only.

a. The automated chemical controller is prototypical for all new facilities constructed by the Owner. Substitutions will not be considered. For purchasing information contact Hercules Solutions, LLC. www.herculessolutionsllc.com Telephone 866.749.8139

b. The automated chemical controller shall be installed with manufacturer furnished sample stream strainer.

H. Ultraviolet Disinfection Systems

1. The ultraviolet disinfection system shall be a Sentry UV system as manufactured by ChlorKing, or equal.

a. The UV sterilizer for the body of water shall be low pressure, high output amalgam.

b. The UV system shall be NSF International Standard 50 listed and certified for use in pools and spas.

c. The UV system shall be comprised of one power supply and one sterilizing chamber (number of lamps in chamber varies with model).

d. The UV chamber shall be capable of being mounted horizontally or vertically.

e. The UV chamber shall be constructed of CPVC or stainless steel (varies with model).

f. The UV system shall have quick disconnect sleeves for easy removal for maintenance and cleaning.

g. The UV system shall include a strainer.

h. The UV system shall be pre-wired, ready for field connection of power tied to the pool pump and control circuits.

i. The UV system shall be capable of operating at 254 nm for sterilizing and 185 nm for oxidizing.

j. The UV system shall include all necessary piping, valves, etc. for a fully operating ultraviolet disinfection unit capable of full recirculation flow bypass.

k. The UV system shall have a light intensity meter monitoring the 254 nm wave length.

l. The UV system shall have an hour meter for tracking operation hours of lamps and sleeves.

m. The UV system shall be capable of functioning in water temperatures between 50 and 130 degrees Fahrenheit.

n. The UV system shall operate at a minimum of 45 mJ/cm^2.

o. The UV system for the spa shall come complete with two (2) 2” attachment nipples on the chamber for connection of bypass flow per Drawings.

I. Advanced Oxidation Process (AOP) Secondary Disinfection System

1. The AOP system shall be a CCW system as manufactured by Clear Comfort.

a. The AOP system for pools greater than 1,000 gallons shall be installed with a diffuser rod or surge tank diffuser and air compressor.

b. The AOP system for pools less than 1,000 gallons shall be installed with a manifold bypass and venturi.

J. Thermometers

1. Thermometers shall be 9” industrial glass thermometers as manufactured by Weiss Instruments, Inc., or equal.
    a. Thermowells: 304 stainless steel thermowell supplied by thermometer manufacturer.
    b. Case: Modern V-shape design with parts molded of GE Valox polyester, in black textured finish. Heavy glass protected front firmly secured against rattles by spring action.
    c. Stem: Precision die cast Zamac alloy.
    d. Locking device: Adjustable case locknut and angle adjusting screw to provide 360-degree positioning of thermometer case and stem.
    e. Tube and Capillary: Blue liquid filled-magnifying lens “Blue Reading” tube. Silicone shock mounted.
    f. Range: 0-160 °F.
    g. Accuracy: 1% of scale range.
    h. Scale: White coated aluminum with permanently baked bold black markings. Locked in place and adjusted through device at top of scale.

K. Heat Exchanger Flow Switch
1. Flow Switch shall be McDonnell and Miller, Series FS4-3S Flow Switch, stainless steel body, 1½” NPT pipe connection.

L. Chemical Feed Pump
1. Chemical feed pumps shall be a single head adjustable output peristaltic pump as manufactured by Stenner Pump Company, or equal.
    a. Pump shall be peristaltic with a 3-point roller design to assist in anti-siphon protection.
    b. Pump shall be self-priming against maximum working pressure.
    c. Pump shall be listed and labeled NSF/ANSI Standard 50 by an ANSI accredited certification organization.
    d. Pump sizes and output requirements vary, refer to equipment lists.

M. pH Buffer System
1. pH buffering systems shall be an Acid Rite system as manufactured by Axiall Corporation.
2. Acid Rite system shall be supplied and installed by Pool contractor.

N. Carbon Dioxide Feed System
1. Carbon dioxide feed system as manufactured by Prominent, or equal.
    a. Complete system shall include regulator, feed unit, diffuser, and all connections. Complete system shall be supplied by a single manufacturer.
    b. Feed Unit: CO_2 from the regulators shall be brought to the feed unit in thick wall 3/8” O.D. polyethylene tubing. Feed system shall include 120-volt AC solenoid operated valve for remote on/off control of CO_2 feed. CO_2 feed unit shall also include rate adjusting flow meter scaled from 5-50 SCFH and have a pressure rating of 100 psi.

c. Diffuser: CO_2 from feed unit shall be injected through ½" NPT fitting. Unit shall cause CO_2 to be totally diffused and made to go fully into solution without evidence of CO_2 bubbling at any point where water is open to atmosphere. Unit must be equipped with a check valve to prevent the flow of water into the feed unit.

O. Flow Monitor System

1. Recirculation system flow meters shall be 9900 SmartPro Transmitter as manufactured by Georg Fischer Signet LLC, or equal.
   a. Flow monitor system shall come complete with magmeter flow sensor (from same manufacturer).
      1) Flow sensor shall produce a blind digital/frequency, relay output.
      2) Flow sensor shall have a flow range of 0.5 to 33 ft/s.
      3) Flow sensor shall have no moving parts.
      4) Flow sensor shall be capable of bi-directional flow and empty pipe detection.
      5) Flow sensor shall be constructed of corrosion resistant materials.
   b. Flow monitor shall be supplied complete with rear cover kit.
   c. Flow monitor shall include a backlit LCD for displaying instantaneous flow rate readings, totalized flow volume and for calibration/setup.
   d. Flow monitor shall include a fully scalable active (internally powered) 4-20 mA output.
   e. Flow monitor shall include two programmable relays.
   f. Device shall have NEMA 4X, CE, and UL approvals/ratings.
   g. Accuracy: 0.5% of reading.
   h. Enclosure: ABS plastic.
   i. Keypad: Silicone rubber.
   j. Panel and Case Gasket: Neoprene.
   k. Window: Shatter-resistant glass with UV coating.

P. Accessory Flow Meters and Sensors

1. Water feature and accessory system flow meters 6" and smaller shall be FlowVis manufactured by H2Flow, or equal.
   a. Accuracy: 3% of scale range
2. Water feature and accessory system flow meters 8" and larger shall be pitot tube insertion flow meters as manufactured by Blue-White Industries, or equal.
   a. Flow sensor shall be one piece machined acrylic body.
   b. Flow meter shall have a corrosion resistant 316 stainless steel internal float
   c. Accuracy: 10% of scale range
3. Water fill system and waterslide flow sensors shall be Georg Fischer Signet LLC paddlewheel flow sensors.
   a. Flow sensor shall produce a blind 4 to 20 mA, digital/frequency, relay output.

b. Flow sensor shall have a flow range of 1 to 20 ft/s.

c. Flow sensor shall be constructed of chemically resistant materials.

d. Flow sensor shall have an easily replaceable rotor.

e. Body: Polypropylene.

f. Rotor: Black PVDF.

g. Pin Material: Titanium.

Q. Water Level Controller

1. The water level controller shall be the Levelor K-1100 as manufactured by Jandy, or equal.

a. An electronic multi water level sensing control system shall be furnished.

b. The water level controller shall come complete with solenoid valve, slip sensor, and sensor housing.

c. Controller

1) Housing and Mounting: The controller shall be housed in a watertight polycarbonate enclosure. The enclosure and connections shall be designed to eliminate any possibility of corrosion and/or damage to the internal components of the controller. The controller shall be factory wired and tested for functionality.

2) Indicators: The controller shall have colored LED indicators indicating applicable system conditions (power, sensor, filling).

3) Timings: Fill on delay shall be 20 seconds. Fill off delay shall be 20 seconds. Max fill time shall be adjustable from 20 to 60 minutes and shall be able to be disabled for continuous filling.

4) Outputs: The solenoid valve output shall be one (1) solid state relay output at 24VAC, 1 A.

d. Sensors

1) Sensors shall be capable of detecting water levels within 1/8” of nominal water level.

R. Bulk Chemical Tank

1. The bulk chemical tank shall be as manufactured by Chemtainer Industries, or equal.

a. Tank shall be molded double wall/dual containment complying with federal regulation 40CFR-264.193 capacity requirements.

b. Primary tank shall be completely contained.

c. Tank shall be supplied with a non-vented manway.

d. Tank shall be supplied with all bulkhead fittings for venting, chemical feed connections, fill pipe connection, and level monitoring as indicated within the Drawings.

e. Fill pipe connection shall be installed with a quick connect fitting for the chemical supply vendor. The required fitting shall be verified with the chemical vendor by the Pool Contractor.

2. Connection to bulk chemical tank shall be made by Pool Contractor via a bulkhead fitting or pre-manufactured connection that will ensure an air tight seal. Pool Contractor shall provide vent stubs for connection by Plumbing Contractor. Tank shall be vented to the exterior through PVC piping by Plumbing Contractor.

S. Secondary Containment Pallets

1. Secondary containment pallets for liquid storage containers shall be constructed of high density polyethylene with removable grate as manufactured by Eagle Manufacturing Company, or equal. Designs that include a drain will not be allowed.

a. Pallets storing pH balancing chemicals shall be capable of supporting four 15-gallon carboys of liquid. Each pallet shall have a minimum capacity of 30 gallons.

b. Pallets storing sodium hypochlorite shall be capable of supporting four 55-gallon barrels of liquid chemicals. Each pallet shall have a minimum capacity of 66 gallons. Furnish with one pallet ramp for the facility.

2.06 POOL COMPETITION EQUIPMENT

A. Racing Lane Lines

1. Racing lane lines shall be Competitor racing lanes and Gold Medal racing lanes as manufactured by Competitor Swim Products, or equal.

a. 4” diameter racing lanes shall be utilized on all indoor applications. 6” diameter racing lanes shall be utilized on all outdoor applications.

b. Competitor race line products are prototypical for all new facilities constructed by the Owner. Substitutions will not be considered.

c. Lane lines shall be supplied complete with assembly and attachment accessories, including a bronze nickel-plated spool encased in a stainless steel tension mechanism to provide customized adjustment of lane torque at one end and a stainless steel spring assembly at the other end to maintain equal pressure during use.

d. All hardware shall be stainless steel or plastic.

e. Color and Pattern:

1) Indoor Lap Pool: 4” diameter. Alternating blue and white color with solid blue color ends (15’ each end). Furnish red colored single disc marker at 15 meters from each end of the lap lanes.

2) Indoor Leisure and Lesson Pools: 4” diameter.

(a) Full length: Alternating blue and white color with solid blue color ends (15’ each end) for full length lane dividers. Furnish the following colored single disc markers from each end of the lap lanes.

- 5’ – Yellow
- 10’ – Green
- 12’ – Purple
- 21’ - Red
- 30’ - Orange

(b) Short length (at end of peninsulas): Alternating blue and white color with colored single disc markers described above at locations to match full length lap lanes (where applicable).

3) Outdoor Lap Pool: 6" diameter.

(a) Full length: Alternating blue and white color with solid blue color ends (15' each end) for full length lane dividers. Furnish red colored single disc marker at 15 meters from each end of the lap lanes.

4) Outdoor Lesson Pool: 6" diameter.

(a) Full length: Alternating blue and white color with solid blue color ends (15' each end) for full length lane dividers. Furnish the following colored single disc markers from each end of the lap lanes.

- 5' – Yellow
- 10' – Green
- 12' – Purple
- 21' - Red
- 30' – Orange

B. Rope Anchors

1. Refer to 2.03.C. of this section for identical equipment.

C. Stanchion Posts

1. Refer to 2.03.D. of this section.
2. Backstroke rope and flags by Owner.

D. Starting Block Platform

1. Starting block platform shall be the Velocity Side Step Platform with Track Start Wedge as manufactured by S.R. Smith, Sprint with Rapid Lock by Spectrum Aquatics, Track Start Side Step Platform with Adjustable Backplate Kit as manufactured by KDI Paragon, or equal.
   a. Starting block platform shall be supplied complete with square base wedge anchor.
   b. Starting block platform frame shall be powder coated. Color similar to S.R. Smith Silver Gray RAL 7038.
   c. Starting block platform shall have slip resistant surface on footboard, wedge, and side step similar to S.R Smith TrueTread. Surface color shall be Blue. Sand finish surfaces will not be accepted
   d. Starting block platform shall include "H" configuration backstroke handle.
   e. Starting block platform shall be supplied complete with starting block cover and locking mechanism. The cover shall be customized with a hole on each side (midpoint) to allow for the cable of the locking mechanism to be threaded through the cover holes and through the starting block rail supports for security and prevention of cover removal/tampering.

1) Starting Block Cover 24x32 Inches, White as manufactured by S.R. Smith or Track Start Safety Cover (24”x32”) as manufactured by Paragon Aquatics, I.D. No. 23967,

2) Adjustable Cable, 6’ adjustable cable length, as manufactured by Master Lock, No. 8417D. Locks shall be keyed identically.

2.07 POOL ACCESSORY FEATURES AND EQUIPMENT

A. Pool Accessory Features

1. Umbrella Feature

a. Umbrella feature shall be as manufactured by Rain Drop Products, LLC, or equal.

b. The specified feature shall be suitable for installation in public swimming facilities and shall be capable of accommodating various rates of water flow from 100-400 gallons per minute.

c. The supplier shall furnish feature complete with all anchoring and fastening devices, required gaskets and base skirt.

d. Design

1) The stem and the umbrella shall be fully assembled in two pieces so that either piece can be individually replaced should damage or vandalism occur.

2) Minimum clear height of 8’ below umbrella.

3) All materials shall be inert to pool chemicals.

4) The umbrella shall be molded fiberglass with a high gloss gel coat finish on the exterior. Colors shall be ultraviolet stabilized to inhibit fading and selectable from manufacturer’s standard palette.

5) The stem/piping shall be twelve inch rigid corrosion proof fiberglass material with a gel coat finish. Attachment flanges shall provide six (6) ¾ inch bolt holes for mounting to umbrella and shall have a similar bolt pattern (6 holes) at the base of the stem. PVC is not acceptable and shall not be used for stems. Colors shall be ultraviolet stabilized to inhibit fading and selectable from manufacturer’s standard palette.

6) Gaskets shall be ¼ inch thick neoprene material.

7) Fasteners shall be type 304 stainless steel for anchor bolts that attach the dome to the stem. Anchor bolts for mounting to foundation shall be thunder stud expansion type anchor bolts. All fasteners shall be supplied by the manufacturer.

8) Base skirt shall be a two piece ABS molded plastic that rigidly attaches to the stem. Colors shall be ultraviolet stabilized to inhibit fading and selectable from manufacturer’s standard palette.

e. Stem color: Rain Drop “Coastal Cool”.

f. Dome color: Rain Drop “Aquamarine”.

2. In-Ground Feature

a. In-ground feature shall be “Pop Jets” as manufactured by Rain Drop Products, LLC, or equal.

b. The specified fountain shall be suitable for installation in zero entry public swimming facilities and shall operate at a water flow rate of 60 gallons per minute.

c. Design

1) The body shall be manufactured from heavy duty, high tensile strength PVC, gas welded and shall be impervious to rust and corrosion.

2) The nozzle shall be adjustable high strength, corrosion resistant HDPE.

3) All nozzles and piping connections shall be made from heavy-duty high tensile strength PVC.

d. Manufacturer to supply high strength PVC plugs and installation instructions for winterization.

B. Pool Accessory Feature Fittings

1. Refer to 2.04 of this section for identical equipment.

C. Pool Accessory Feature Equipment

1. Refer to 2.05 of this section for identical equipment.

2.08 SURGE AND RECIRCULATION TANK EQUIPMENT

A. Access Hatch

1. Surge tank access hatch shall be type “K-2” as manufactured by Bilco Company, or equal.
2. Size: 30” x 30”.
3. Cover: Shall be reinforced to support a minimum live load of 150 psf with a maximum deflection of 1/150th of the span.

a. The vault access door shall be single leaf and pre-assembled from the manufacturer.

b. Operation of the cover shall be smooth and easy with controlled operation throughout the entire arc of opening and closing

c. Operation of the cover shall not be affected by temperature.

d. Cover shall be constructed of ¼” aluminum diamond pattern plate.

e. Cover shall be equipped with a steel hold open arm that automatically locks the cover in the open position.

f. Cover shall be fitted with the required number and size of torsion bars.

4. Frame: Shall be ¼” extruded aluminum with strap anchors bolted to the exterior.
5. Hinges: Shall be specifically designed for horizontal installation and shall be bolted to the underside of the cover. Cast steel cam-action hinges which pivot on torsion bars shall be furnished.
6. Lifting mechanisms: Cam-action hinges shall pivot on torsion bars to provide smooth, easy, and controlled cover operation throughout the entire arc of opening and to act as a check in retarding downward motion of the cover when closing.

7. A removable exterior turn/lift handle with a spring-loaded ball detent shall be furnished to open the cover.
8. A type 316 stainless steel snap lock with fixed handle shall be mounted on the underside of the cover.
9. All hardware shall be type 316 stainless steel.
10. Factory finish for indoor surge tank hatch shall be mill finish aluminum with bituminous coating applied to the exterior of the frame.
11. Factory finish for outdoor surge tank hatch shall be mill finish aluminum with powder coating applied to all visible parts of the frame and door (when door is closed).
    a. Two coats of powder coating for exterior commercial use with heavy pedestrian traffic. Coat twice to obtain 3.5 – 5 mils thickness on edges and corners.
        1) Color: To match deck paver color, by Owner.

B. Manhole Steps
1. Manhole steps shall be mechanical lock style as manufactured by American Step Company, Inc., or equal.
2. Steps shall be constructed of grade 60 steel reinforcement surrounded (completely) by a formed step constructed of copolymer polypropylene.
3. The steps shall meet or exceed ASTM C478 and OSHA standards when properly installed.
4. The step surface shall be textured or patterned to provide a non-slip surface.

2.09 MAINTENANCE AND CLEANING EQUIPMENT

A. The Pool Contractor shall supply the following maintenance and cleaning equipment:
1. Pool Vacuum System
    a. Pool vacuum system as manufactured by Pool Weasel, or equal.
    b. Complete pool vacuum system shall include:
        1) Pool Weasel vacuum base unit.
        2) 75’ of 1 ½” heavy duty vacuum hose.
        3) 12’-22’ telescopic fiberglass pole.
        4) 29” vacuum head.
        5) 12” clear vinyl spa algae vacuum head.
        6) 3’ brown spiral return line.
        7) 50’ lite plug extension cord.
        8) Hose hugger.
        9) Tube of magic lube.
        10) Waste adapter.
2. The following cleaning accessories as manufactured by Pentair Water Pool and Spa, or equal:
    a. Heavy duty skimmer, aluminum rod and frame.
    b. 18” wall brush with stainless steel algae bristles.

c. Fiberglass telescoping pole, 8’-0” to 16’-0”.

3. Complete commercial pool test kit as manufactured by Taylor Technologies, or equal.

2.10 ACCESSIBILITY EQUIPMENT

A. Pool Lifts

1. Stationary pool lifts shall be the aXs2 lift as manufactured by S.R. Smith.

a. Pool lift shall be supplied complete with battery, charger, battery console cover, waterproof control, stainless steel anchor socket (with cover), footrest and seat belt assembly.

b. Pool lift specified outdoors shall be supplied with a caddy.

c. Pool lift specified indoors shall be caddy-compatible.

d. Pool lift shall be supplied with arms rests.

e. Pool lift shall be 3rd party tested and verified ADA compliant.

f. Pool list shall have 300 lb. lifting capacity.

g. Pool lift shall be easily removable from stainless steel deck anchor.

h. Pool lift shall be constructed of powder-coated stainless steel and aluminum. Powder coated stainless steel color shall be similar to brushed stainless steel, equal to S.R. Smith “Silver Gray” RAL7038.

i. Pool lift specified is prototypical for all new facilities constructed by the Owner. Substitutions will not be considered.

B. Transfer Rails

1. Transfer rails shall be TR-12B-LT as manufactured by S.R. Smith.

a. Transfer rail shall be fabricated of 1.50” O.D. x 0.120” wall thickness, 304 stainless steel.

b. Transfer rails shall be wrinkle free.

c. Transfer rails shall have a baked powder coat finish that includes a primer, basecoat, and clear coat finish. The powder coat system shall have a minimum total thickness of 5 mil over the entire exterior surface of the rail. Color to be similar to brushed stainless steel, equal to S.R. Smith “Silver Gray” RAL 7038.

d. Transfer rails shall be manufactured to conform to setbacks and lengths as indicated within the Drawings.

e. Transfer rails shall comply with the 2010 ADA Standards for Accessible Design.

PART 3 EXECUTION

3.01 EXAMINATION

A. Field verify conditions prior to start of work and notify General Contractor of any discrepancies between encountered conditions and those indicated within the Drawings and herein.

3.02 PREPARATION

A. Protect all adjacent surfaces, equipment, etc. to remain from damage during course of work. Restore any damaged areas or equipment.

3.03 INSTALLATION

A. Install all equipment in accordance with manufacturer's recommendations.

B. Furnish all appurtenance and ancillary equipment necessary for complete installation of all equipment.

C. Install all work and equipment plumb, true, square, straight, and level. Anchor securely in place per manufacturer's recommendations or in accordance with general industry practices.

D. All equipment shall be labeled for each system.

E. Health, Life, and Safety Equipment

1. Lifeline rope and floats.
    a. Install lifeline rope and floats prior to final acceptance.
    b. Utilize clamp-type rope hooks for connection to cup anchors at pool wall.
        1) Trim all rope ends within ½ inch of clamp and treat ends to prevent fraying.
    c. Ensure rope is installed tight with minimum sag.
    d. Install floats at minimum five foot spacing. Space floats evenly across length of lifeline.
2. Life hook.
    a. Install life hook pole hangers utilizing hardware provided by manufacturer. Install at locations necessary for compliance with jurisdictional requirements.
    b. Prior to installation, obtain approval of location from General Contractor, Owner, or Architect.
3. Ring buoy.
    a. Install ring buoy hangers utilizing hardware provided by manufacturer. Install at locations necessary for compliance with jurisdictional requirements.
    b. Prior to installation, obtain approval of location from General Contractor, Owner, or Architect.
4. Lifeguard chair.
    a. Fully assemble lifeguard chair.
5. Underwater Lights
    a. Install conduit in pool structure prior to placement of concrete. Pool Contractor shall supply and install conduit to five (5) feet behind the pool wall (remaining conduit by Electrical Contractor).
        1) Install niche in formwork prior to placement of concrete (protect face and interior from concrete).

            (OR)

        2) Create grout pocket for installation of niche following concrete placement.
            (a) Scarify grout pocket bonding surface to minimum one-quarter (1/4) inch amplitude.
            (b) Install light niche and grout in place.

b. Installation of light, electrical connections, and grounding by Electrical Contractor. Coordinate work and assist in final light and face ring installation.

6. Signage

a. Contractor shall coordinate with Owner required sign location for compliance with applicable jurisdictional requirements.

b. Pool Contractor is responsible for ensuring that the appropriate signage is in compliance with all jurisdictional requirements and typical industry standards.

F. Pool Process Fittings

1. Hydrostatic relief valve and collector tube.

a. Hydrostatic relief valves shall be installed in each main drain and accessory feature sump.

b. Install extension between relief valve and collector tube to allow placement of tube below concrete sump. Ensure that all tube openings lie completely within the rock base below the concrete sump.

2. Inlets

a. Balance inlet system. Adjust flow and direction of all inlets for optimum distribution and circulation within pool.

G. Pool Process Equipment

1. Strainers

a. Install strainer at appropriate elevation for pump placement and piping.

b. Install a concrete equipment pad below the strainer at the determined elevation prior to strainer operation (filling with water).

c. Ensure strainer weight is distributed to the concrete pad with no strain transmitted to the connecting pipes.

2. Horizontal Close Coupled End Suction Centrifugal Pumps

a. Install pump at appropriate elevation for piping connections and to ensure flooded suction (to top of volute). Notify Engineer immediately if sufficient pump pit depth is not available to provide flooded suction. The Contractor shall be responsible for verifying that flooded suction is attainable prior to final installation of the pump.

b. The Contractor shall ensure that the pumps and motors are properly installed with no pipe strain transmitted to the pump casing.

c. A permanent concrete equipment pad shall be installed below the pump as detailed in the Drawings prior to operation.

d. Drilled-in expansion anchors that rely solely on friction shall not be used for anchoring of the pumps. Cast-in-place anchor bolts are preferred. Alternately, epoxy-grouted anchor bolts may be considered with approval of the Engineer where drilled-in anchors are necessary. The anchors shall be installed such that the pump motor can be easily removed for maintenance.

e. Installation shall include furnishing the required oil and grease for initial operation. The grades of oil and grease shall be in accordance with the manufacturer's recommendations.

3. Self-priming Centrifugal Pumps

    a. Install pump at appropriate elevation for piping connections.

    b. The Contractor shall insure that the pumps and motors are properly installed with no pipe strain transmitted to the pump casing.

    c. The pump shall be permanently anchored to a concrete equipment pad or the concrete floor slab. The anchors shall be installed such that the pump motor can be easily removed for maintenance.

    d. Installation shall include furnishing the required oil and grease for initial operation. The grades of oil and grease shall be in accordance with the manufacturer's recommendations.

4. Variable Frequency Drives

    a. Contractor to verify that job site conditions for installation meet factory-recommended and code-required conditions for VFD installation including clearance spacing, temperature, contamination, dust, and moisture of the environment.

    b. The VFD is to be covered and protected from installation dust and contamination until the environment is cleaned and ready for operation. The VFD shall not be operated while the unit is covered.

    c. A factory-authorized service technician shall perform start-up on each drive. A start-up service report shall be provided.

    d. VFDs connected to recirculation pumps shall receive a 4-20 mA flow signal from the chemical controller and be programmed to maintain constant flow at the design flow rate.

        1) Contractor to include in their Operations Manual and Instructional Training directions to manually override the pre-programmed flow rate to meet the required backwash flow rate or drain-down flow rate.

        2) The backwash rate and drain-down flow rate shall be printed on labels and placed on the VFD housing.

    e. VFDs connected to slide, feature, or hydrotherapy pumps shall be programmed to maintain the design flow rate. The design flow rate shall be calculated with the pump operating at full speed utilizing the pump pressure, vacuum gauges, and pump curve. Calculated flow rate shall be within 5% of the design flow rate.

5. Sand Filtration Systems

    a. All sand filters shall be set level according to the manufacturer's instructions and recommendations.

    b. Support media shall be placed by hand to avoid damage to the filter internal components.

    c. Support media shall be leveled before the addition of the upper layer of filter media.

6. Automated Chemical Controller

    a. THOR L800/L400 chemical controller to be installed with low voltage wiring by a factory trained representative.

    b. Calibrate and program the chemical controller on all pools and spas to include the following functionality:

1) Sample Stream Magnetic Flow Switch
    (a) Factory wired to Digital Input “1” for single vessel installation – Digital input #5 for second vessel if applicable
    (b) Data Log Flow/No Flow through sample stream
    (c) Lock out chemical feed if no flow
2) Sample Stream pH Probe
    (a) Connected via M12 connector on factory provided Data/Power modbus cable
    (b) Data Log pH
    (c) Initiate pH feed if pH is 7.5 or above
    (d) Stop pH feed if pH is 7.3 or below
3) Sample Stream ORP Probe
    (a) Connected via M12 connector on factory provided Data/Power modbus cable
    (b) Data Log ORP
4) Sample Stream Temperature Probe
    (a) Shall be integrated with pH/ORP sensor
    (b) Data Log temperature (^{O}F)
5) Lyzner Saturation Index
    (a) Manual input calcium hardness (ppm)
    (b) Data log calcium hardness
    (c) Data log calcium hardness input date and time
    (d) Manual input alkalinity (ppm)
    (e) Data log alkalinity
    (f) Data log alkalinity input date and time
    (g) Data log calculated Lyzner Saturation Index based on manually input calcium hardness and alkalinity
6) Recirculation Flow (gpm)
    (a) Field wire 4-20mA signal from flow transmitter to input “2” for single vessel and input “6” for second vessel (where applicable)
    (b) Data log recirculation flow (gpm)
    (c) Lock out chemical feed if no flow
    (d) Field wire 4-20mA output signal from controller to Variable Frequency Drive
7) Fill Water Sensor
    (a) Field wire pulse input from flow sensor to input “2” for single vessel and input “6” for second vessel (where applicable)
    (b) Data Log totalized fill water (gallons)
8) pH Feed Factory Whip
    (a) Factory wired to output “2” for single vessel and input “6” for second vessel (where applicable)

9) Chlorine Feed Factory Whip

(a) Factory wired to output “1” for single vessel and input “5” for second vessel (where applicable)

c. Additional calibration and programming the required on all indoor pools and spas also include:

1) Sample Stream Free Chlorine (PPM) Probe

(a) Factory Wired to Analog Input “1” for single vessel and Analog Input “5” for second vessel (where applicable)

(b) Data Log free chlorine

(c) Send feed signal to chlorine feeder if free chlorine falls below 1.0 ppm on pools or 2.0 ppm on spas

(d) Stop chlorine feed when free chlorine reaches 1.5 ppm or above on pools and 3.0 and above on spas

d. Additional calibration and programming the required on all outdoor pools and spas to also include:

1) Sample Stream Total Chlorine (PPM) Probe

(a) Factory wired to Analog Input “3” for single vessel and Analog Input “7” for second vessel (where applicable)

(b) Data Log total chlorine

(c) Send feed signal to chlorine feeder if free chlorine falls below 1.5 ppm on pools or 2.5 ppm on spas

(d) Stop chlorine feed when free chlorine reaches 2.0 ppm or above on pools and 3.5 and above on spas

e. Additional calibration and programming the required on all spas to also include:

1) Sample Stream Total Conductivity Probe

(a) Field connected via M12 connector on factory provided Data/Power modbus cable.

(b) Data Log total dissolved solids (ppm)

f. Additional flow sensors for water slide flow (gpm)

1) Slide “A” Open Flume

(a) Field wire pulse input from flow sensor to input “4”

(b) Data log slide flow rate (gpm)

2) Slide “B” Enclosed Flume

(a) Field wire pulse input from flow sensor to input “3”

(b) Data log slide flow rate (gpm)

7. Advanced Oxidation Process (AOP) Secondary Disinfection System

a. The unit shall be permanently wired. Internal wiring shall be listed for R/C (AVLV2) with minimum 1/32” thick insulation, rated 240V, 105°C.

b. The unit shall operate continuously.

c. The enclosure and all other metal that could become energized and is accessible to a person servicing the equipment shall be bonded to the equipment grounding bus or connection.

1) Diffuser rod installation:

   (a) The unit shall be installed on pools larger than 1,000 gallons.

   (b) The unit shall be located in the pool equipment room as close as possible to the tapped injection site, no further than 15 linear feet of tubing.

   (c) The installation kit shall include the AOP system, air tubing, air check valve, compressor, diffuser rod, flow switch interlock, junction box and tooling for drilling and tapping the 1 inch hole for the flow switch and diffuser rod.

   (d) The unit shall be wall mounted (CCW300 or CCW300A) or floor standing (CCW500).

   (e) The diffuser rod shall be tapped either before the surge tank or after the heater and prior to chemical injection by a minimum of 3 feet. The diffuser length shall be ½" less than the pipe I.D. where it is located.

   (f) If using erosion feeders, the injection point shall be after the influent to the erosion feeder bypass and three to five feet upstream from the erosion feeder bypass return.

   (g) The compressor shall be protected from the elements.

   (h) The compressor for the CCW100 and CCW300A is 1/16 Hp (50-Watt) and is supplied by the manufacturer.

   (i) The compressor for the CCW300 is 1/8 Hp (90-Watt) and is supplied by the manufacturer.

   (j) The compressor for the CCW500 is 1/4 Hp (190-Watt) and is supplied by the manufacturer.

   (k) All models shall be permanently connected and are prewired for 120V (confirm voltage when purchasing).

   (l) All models are intended for both indoor and outdoor use. Unless specified otherwise, all internal wiring is minimum 1/32 inch thick insulation, rated 240V, 105°C.

   (m) All systems shall operate continuously. Flow switch interlock is included.

   (n) Air flow meter shall be used to calibrate the specified range of air volume (LPM). Do not exceed the maximum flow rate.

2) Bypass installation:

   (a) The unit shall be installed on pools smaller than 1,000 gallons.

   (b) The unit shall be located in the pool equipment room as close as possible to the venturi injection site, no further than 10 linear feet of tubing.

   (c) The unit shall be wall mounted (CCW100).

   (d) The venturi bypass shall be constructed out of PVC, as dictated by code or the Drawings. Removal of the 2" bypass line shall occur after the heater, and the return leg of the bypass shall occur after the heater, but before the chemical injection site. The bypass removal line can be constructed by the use of collars, saddles, or by tapping directly into the main return line of the pool.

(e) A factory built 2” manifold shall be installed.

(f) The 1.5” Mazzei 1583 venturi shall be plumbed as close to the main pool return line as possible.

(g) Hydroxyl injection shall occur prior to chemical injection by a minimum of 3 feet.

(h) An air check valve shall be installed above the venturi in a vertical orientation.

(i) An air flow meter shall be used to calibrate the specified range of air volume (LPM). Do not exceed the maximum flow rate.

8. Thermometers
   a. Each pool recirculation system shall include the installation of a minimum of three (3) thermometers.
      1) One (1) thermometer shall be installed in the main piping (full flow) after the heater bypass and one (1) thermometer shall be installed on each heat bypass inlet and outlet.
9. Chemical Feed Systems
   a. Chemical feed pumps shall be located within the chemical enclosure. All chemical tubing from the feed pump to the pool return piping shall be continuous without splices, breaks, etc.
   b. Chemical feed injection points are to be installed after all equipment bypasses and all sample stream returns. Injection points shall be at the lowest elevation feasible and in close proximity to the point where the recirculation return pipe (to pool) exits the equipment room.
10. Flow Monitor System
    a. Applicability
       1) Flow monitor system shall be utilized as main flow sensing instrument for all pool recirculation systems.
    b. Install minimum straight pipe lengths for flow sensor as required by manufacturer. Install additional straight line piping runs as required.
    c. Flow monitor to be wired to the chemical controller for data logging and transmission of the flow signal to the VFD.
    d. Calibrate flow monitor system during pool recirculation system start-up based on the calculated flow rate with the pump operating at full speed utilizing the pump pressure, vacuum gauges, and pump curve. Displayed flow rate to be accurate within 2% of the calculated flow rate.
11. Accessory Flow Meters and Sensors
    a. Applicability
       1) FlowVis flow meter shall be utilized as flow meter for all water feature systems that are 6” or smaller and heat exchanger bypass piping.
          (a) Flow meter shall be installed on heat exchanger influent piping after the service valve and within eyesight of the heat exchanger bypass valve.

2) Paddlewheel flow sensors shall be utilized for all waterslide supply (each individual slide supply) and water fill systems (individual water fill to each vessel).

b. Install minimum straight pipe lengths for flow sensor as required by manufacturer. Install additional straight-line piping runs as required.

12. Bulk Chemical Tank

a. All connections to tank for fill and chemical feed shall be completely sealed.

b. Install vent connection stub as indicated within the Drawings.

13. Water Level Controller

a. The sensor housing for spa water level control systems shall be installed within a field fabricated deck well as indicated within the Drawings.

b. The sensor housing for pool water level control systems shall be installed within a field fabricated assembly fastened to the surge tank wall as indicated within the Drawings.

END OF SECTION

SECTION 13 14 13
WATER SLIDES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Waterslides:
      a. 42” Open Body Slide
      b. 32” Diameter Enclosed Body Slide

1.02 RELATED SECTIONS

A. Section 03 30 00 “Cast-In-Place Concrete”

1.03 DESCRIPTION

A. Work Included
   1. Furnish and install fiberglass waterslides and special effects as indicated on the Drawings, specified herein, and as necessary for proper completion including, but not necessarily limited to:
      a. Minimum Qualification requirements
      b. Design and Engineering Requirements
      c. Insurance Requirements
      d. All fiberglass flume components.
      e. All flume structural support systems.
      f. Tower, platforms, stairs, railings, and related supports.
      g. Installation supervision, ride testing and certification.
      h. Labor to complete the installation of the waterslides, supports and tower(s).
      i. Operations and Maintenance manuals.
      j. On-site training of entire Swimming Pool Staff.
      k. Proper Signage.

B. Related work specified elsewhere: (to be completed by others)
   1. All demolition and repairs to decks, fences, and landscaping.
   2. All electrical works, buildings, permits, and modifications if any to the pool walls and waterslide areas. All necessary utilities required for installation and operation of the waterslide and special effects areas (if applicable) as specified by manufacturer.
   3. Installation and supply of mechanical and electrical equipment, including but not limited to waterslide pumps, controls and switches, electrical connections and wiring, and related piping clear to starter tubs. Drainage, ballast tanks, filtration, pumps etc. for runout and splashdown pools if applicable. Grating if applicable.
   4. The waterslide manufacturers will need adequate access at all times to and around the area of the waterslide. At a minimum the manufacturer will need unobstructed access for a man lift and an 8000 lb. Lull.

C. Concrete foundations:

1. Concrete foundation design shall be completed by the slide manufacturer and constructed by the general contractor or pool builder.

2. Anchor bolts for the slide foundations shall be hot-dipped galvanized and supplied by the waterslide manufacturer.

D. Materials:

1. The waterslide(s) tower and stairways, structural steel supports and fiberglass shall be installed by the slide manufacturer or by a manufacturer certified installation company.

E. Color:

1. Color shall be integral to the fiberglass. Fiberglass color shall be selected from a minimum of 170 RAL standard colors supplied by the waterslide manufacturer.

1.04 QUALITY ASSURANCE

A. Qualifications of Suppliers and Personnel

1. The waterslide flume manufacturer shall have not less than (5) years' experience in the design and fabrication of similar fiberglass waterslides. The manufacturer shall provide appropriate Performance and Labor/Material payment bonds if required.

2. The waterslide erection supervisor shall not have less than five (5) years' experience in the erection of fiberglass waterslides.

3. Product quality is of utmost importance. The waterslide manufacturer shall submit evidence of written Quality Assurance Program a minimum of 60 days prior to bid date to be considered as qualified at the sole discretion of the Aquatics Designer.

4. Manufacturer shall provide proof of insurance 30 days prior to bid date illustrating a minimum of $1,000,000 general and product liability as well as an additional $5,000,000 excess umbrella liability per occurrence. Manufacturer shall also provide proof of worker's compensation and employer's liability coverage with policy limits of $1,000,000 per line item of coverage and proof of errors and omissions liability claims made coverage in the amount of $1,000,000 each claim.

5. Dimensions and footing layout and design will vary between manufacturers. Those items shown on Plans and specified are intended to establish minimum standards.

a. For bidding purposes, bidding contractors shall anticipate deviations from items shown on the plans and specified herein and submit his or her bid accordingly.

B. Codes and Standards

1. In addition to complying with the waterslide manufacturer's specified requirements, comply with pertinent recommendations contained in:

a. Waterslide flumes shall comply with "WWA Considerations for Operation Safety", 1989 and update, as published by the World Waterpark Association.

b. "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings" of the American Institute of Steel Construction 9th edition.

c. "Code for Welding in Building Construction" of the American Welding Society.

d. "Specifications for Architecturally Exposed Structural Steel" of the American Institute of Steel Construction 9th edition.

e. “Manual of Standard Practice for Detailing Reinforced Concrete Structures”, Publication ACI 315-92 of the American Concrete Institute.

f. “Structural Concrete for Buildings”, Publication ACI 301-96 of the American Concrete Institute.

g. ASTM requirements for all steel components, of the American Society of Testing Materials.

h. “Standard Practice for Classification, Design, Manufacture, Construction, and Operation of Water Slide Systems”, ASTM F2376-13.

i. Utah Code R392-302: Design, Construction, and Operation of Public Pools (Current Revision)

j. Salt Lake Valley Health Department Health Regulation #2: Design, Construction, and Operation of Pools Regulation (Current Revision)

k. Where provisions of pertinent codes and standards conflict with this specification, the more stringent shall govern.

C. Manufacturer Qualifications:

1. Company specializing in manufacturing products specified in this section with not less than five years of documented experience.

D. Installer Qualifications:

1. Company specializing in performing the work of this section with minimum 5 years of experience. Must meet all Workers Compensation requirements.

E. Engineering Qualifications

1. Design waterslides under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State/Province of __UTAH__.

1.05 SUBMITTALS

A. Those who wish to be considered for the mandatory pre-approved process must submit and receive approval (at the sole discretion of the Aquatics Designer), a complete AutoCAD plan view and elevations of all waterslide designs as well as specifications. Drawings, Data, Test Results and other pertinent information listed above must be sent to Lifetime Fitness. See pre-approval.

B. Engineered drawings

1. Within thirty (30) days after award of contract, and before any materials are delivered to the job site, submit the following drawings to the Aquatics Designer for approval:

a. Slide path design with X. Y, Z (elevation) coordinates.

b. Flume component details, including interface at slide entry and exit.

c. Flume structural support system details.

d. Foundation plans and details as required for flume structural support. Foundations shall be concrete spread footing and pedestal design. Top of pedestal shall be above finish grade.

e. Mechanical schematic.

f. Schematic for slide and pool wall interface.

2. Show all welds as currently recommended symbols of the American Welding Society.

3. All shop drawings shall be certified and sealed by a Professional Engineer registered in the State/Province where the slide is being installed.
4. The slide manufacturer shall certify to the Owner that the depth, width and length of the receiving pool(s) are acceptable and compatible with safety standards for the manufacturer's designed product.
5. The slide manufacturer shall certify to the Owner that the specified minimum width and length of the fiberglass flumes as described in PART 2, Section 2.01 WATERSLIDE RIDES, Paragraph D. item 1, line a. thru c. has been satisfied.

1.06 WARRANTY

A. All work of this section shall be warranted against all defects of material and/or application for a period of one (1) year from date of acceptance. Any failures that may occur within this warranty period, due to defective installation and/or materials, shall upon written notification of such failure be repaired or replaced in a timely manner.

PART 2 PRODUCTS

2.01 WATER SLIDE RIDES

A. Fiberglass Laminate Materials:
1. Gelcoat: Interior gelcoat shall be high quality isophtalic polyester with U.V. inhibitors. 18 to 20 mils thick ride surface, 20 mils exterior coating. Translucent fiberglass shall also have exterior UV protection clear coat. Follow instructions in Gel Coat Application Procedure ISO PP 025.0 and Control Spray Procedure ISO PP020.0
2. Resins: Thixotropic promoted low profile polyester resin with alternate layers of continuous roving chop and 18 oz. woven roving. No fillers shall be allowed in the fiberglass laminate materials.
3. Structure: Fiberglass lamination with sandwich panel centerline reinforcement. Standard flume section shall be 3/16" thick, minimum weight 20 oz. per square foot. Flanges shall be a minimum 1/4" thick and extend at least 3-3/4" from the slide surface, "L" type. Verify Gel Coat thickness using a mil gauge as descried in Mil Gauge Procedure ISO PP095.0.
4. Confirm proper cure level on the gel coat following the guidelines in Barcol Impressor Procedure ISO PP090.0.
5. Apply chopped glass reinforcement according to specified thickness using Spray Up Procedure ISO PP030.0 and Control Spray Procedure ISO PP020.0.
6. Verify laminate thickness using a mil gauge as described in Mil Gauge Procedure ISO PP095.0.
7. Verify proper cure on the part per guidelines in Barcol Impressor Procedure ISO PP 090.0.
8. Using guidelines in De-Molding Procedure, ISO PP 075.0, remove the completed part from the mold.
9. Trim edges and perform required cut outs per customer specifications.
10. Inspect part to verify compliance to specifications and apply required quality sticker per Quality Inspection Procedure ISO PP145

B. Joints, Connections and Seams:
1. Flume to flume fiberglass joints shall be fastened with 3/8" diameter 304L stainless steel bolts, washers (2 per bolt), and lock washers.

2. Flume to support system connections shall be made with galvanized steel hardware and shall be connected separately from waterslide section connections to the exterior flange of the flume. Hardware will not be painted.
3. All connections shall be external to flume interior. No connection, hardware or penetration shall be made to flume interior.
4. Fiberglass joint connections shall be made using waterproof non-shrink marine-grade caulking with suitable adhesion to fiberglass. Silicone sealants will not be permitted. Caulking shall be supplied by the slide manufacturer.
5. All joints shall have a minimum of 3 layers of custom rubber gasketing to prevent leaks.
6. Fiberglassing over seams within the riding surface is not permitted. Sanding within the slide surface should be minimized to maintain adequate gel coat thickness and gloss. Any sanded areas shall be polished to a high gloss until undetectable.

C. Color:
1. Color shall be integral to the fiberglass. The color shall be:
a. Exterior Color: RAL 5007 – Brilliant Blue
b. Interior Color: RAL 7035 – Light Grey

D. Waterslide Configurations:
1. All waterslide layout (s) have been developed utilizing slide path designs provided by Splashtacular, Inc. Ride configurations include:
a. Slide A: Open body slide with a minimum inside riding surface width of 42” as well as a minimum centerline length of <135.50’ or 108.08’> as shown on the drawings complete with fiberglass starter section and including a skirted end cap with return flange back to pool wall.
b. Slide B: Enclosed body slide shall be designed to have a minimum inside diameter of 32” as well as a minimum center line length of <107.29’ or 89.03’> as shown on the drawings complete with fiberglass starter section and including a skirted end cap with return flange back to pool wall.
c. All slides shall share a common tower with a platform height of <17’-6” or 12’-10”> above pool deck level.
2. Length shall include the starter tub and end cap (return flange)
3. Alternate slide manufacturers will be considered. All rides must commence and terminate at the same location and elevation, meet minimum centerline lengths and configuration, and meet the minimum inside width. Water safety zones must not exceed the plunge area shown on the drawings. Tower height and stair termination location shall be as shown on the drawings. All other features of the specifications shall be met.

E. Required Components
1. Starter tub shall be pre-plumbed for water injection downstream of the rider entry point. Starter tub entry area shall be a non-skid surface, no steps are permitted.
2. Riser sections are required on open flume slides for ride safety and to control water loss and shall be furnished on all curved flume sections. Risers shall be integral to the flume; bolt-on sections will not be acceptable.

3. Riser ends to provide a smooth transition at the beginning and ending of each riser shall be furnished integral to the flume section.

4. The flume shall be perpendicular to the pool wall for at least ten feet from its end and shall not slope greater than one foot vertical in last ten feet and meet State code requirements.

5. End cap sections shall provide a smooth finished end piece, which provides safe pool entry masks connection to the pool. Starter tub section shall terminate between six inches below and two inches above the water level and meet applicable code requirements. End cap section shall have a skirt returning to pool wall.

6. Factory pre-drilling of sections.

7. Marine-grade waterproof joint sealant as described.

8. Custom triple rubber gasketing system.

9. Fiberglass to fiberglass assembly hardware shall be 304L stainless steel.

F. Flume Structural Support System:

1. Structural steel support columns, arms and cross bracing as required by the design to support the waterslides. All steel components shall be hot-dipped galvanized for maximum corrosion protection.

2. Connecting hardware and yokes as required by the design. Connecting hardware to attach the slide to structural components shall be hot-dipped galvanized steel, nuts, bolts, and washers. Yokes for connecting flumes to structural elements shall be hot-dipped galvanized steel fabricated to match the exterior flume flange as a minimum standard.

3. Slide manufacturer shall design all concrete footings, foundations and columns as required for the waterslide design. Slide manufacturer shall submit preliminary foundation layout plan showing quantities, typical dimensions, and typical details with their bid.

G. Column Support System:

1. A single or multiple column system shall be used.

H. Waterslide Tower and Stairway System:

1. Tower columns, cross-bracing, tension rods, stairway supports, stairway sections and handrailing shall be hot-dipped galvanized and designed and prefabricated for bolt-up installation, no field welding allowed. Guardrail balustrades shall be hot-dipped galvanized rectangular steel tubing.

2. Manufacturer shall furnish a hinged gate at the base of the waterslide tower.
   Prefabricated stairway sections shall include stringers, constructed of hot-dipped galvanized steel.
   Stair treads will be <52 inch or 40 inch> wide (<48 inches or 36 inches> between grabrails, with grabrails on both sides of the stairs) pultruded fiberglass treads with an integral riser and bottom plate. Decks and landings will be pultruded fiberglass treads with an integral bottom plate.

3. Rail system shall be a minimum of 42 inches high when measured from the stair nosing with the exception of the top landing which shall be a minimum of 50 inches high. Guard railing and balustrades shall be hot-dipped galvanized steel. Handrails shall be hot-dipped galvanized steel.

I. Structural Systems:

1. Structural supports, tower and walkway systems shall be designed to safely support these facilities given the following design criteria:
    a. Seismic: earthquake motions determined according to ASCE/SE 7-10
    b. Ultimate wind speed of 120 mph. *(Verify with Structural design load table)*
    c. Snow load of 70 psf. *(Verify with Structural design load table)*
    d. Live load of 100 psf.
    e. Other criteria as may be required by local regulatory authorities.
2. All concrete/footings shall have a minimum 28-day compressive strength of 4,000 psi.
3. W shape steel shall meet the requirements of ASTM A992, Grade 50.
4. Channels, angles, plates, and miscellaneous steel shapes shall meet the requirements of ASTM A36.
5. Structural tubing rectangular sections shall meet the requirements of ASTM A500, Grade B, (Fy = 46 ksi)
6. Structural tubing HSS 16.00 x 0.250 shall meet the requirements of ASTM A500, Grade B, (Fy = 42 ksi)
7. Steel pipe and 24"Φ x ¼" columns shall meet the requirements of ASTM A53, Grade B, (Fy= 35 ksi)

J. Bolts and nuts:

1. High Strength Bolts:
    a. All high strength bolts shall meet the requirements of ASTM 325N (Snug Tight) and/or A325SC (Fully Pre-Tensioned) where noted.
    b. Use high strength friction bolts for all steel-to-steel bolted connections unless otherwise indicated.
    c. Bolt holes shall be 1/16 inch greater than bolt size (Standard Holes), unless noted otherwise. All bolt holes larger than the standard hole shall be considered oversized or slotted and require the installation of a washer.
    d. All bolts, nuts and washers for steel-to-steel connections shall be hot-dipped galvanized.
2. Anchor Bolts:
    a. All anchor bolts shall hot-dipped galvanized and meet the requirements of ASTM A-F1554 (Fy = 36 ksi).

K. Steel Protection:

1. After galvanizing all steel components shall be brush abrasive blasted in accordance with SSPC-SPS-7. All steel shall then be cleaned, rinsed and oven dried at 400 degrees Fahrenheit. All steel shall then be coated with one coat of Powdura RAL Series Super Durable TGIC-Free Polyester powder coating. Coating mils will be determined by the color chosen by the client but at a minimum 2.5 to 3.5 mils will be applied. The steel shall then be oven cured at 380 to 390 degrees Fahrenheit. All galvanizing and powder coating shall be factory applied.
    a. Colors:

1) RAL 7039 – Quartz Grey

(a) Location: Slide structure and supports, tower stringers and landings.

2) RAL 7035 – Light Grey

(a) Location: Stair tower guardrails and handrails.

3) RAL 7004 – Signal Grey

(a) Location: Stair treads and risers.

L. Safety Signage

1. Waterslide manufacturer shall furnish a minimum of 2 signs for each waterslide tower listing safety rules and riding instructions. Sign shall be a rigid plastic or aluminum material and suitable for exterior installation.

M. Platform Covers

1. The upper platforms and slide entry sections shall be protected from sun by a hot dipped galvanized steel frame covered with acrylic fabric or woven vinyl impregnated polyester yarn. Fabric shall be attached to pipe frame using straps, spring clips and ratchet straps. Bottom of shade shall be 7 foot 6 inches above the finished floor of the waterslide tower. Fabric color shall be Aquatic Blue (Splashtacular).

N. Training and Certification

1. Waterslide manufacturer shall provide on-site training by a management representative from the company as well as a certification letter. Waterslide manufacturer will require two-week advance notice for scheduling Training and Certification.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Inspection:

1. Prior to installation of the work of this Section, carefully inspect the installed work of other trades and verify that all such work is complete to the point where this installation may properly commence.

2. Verify that fiberglass slides and structural support systems are fabricated and erected in strict accordance with original design.

B. Discrepancies:

1. In the event of discrepancy, immediately notify the Engineer.

2. Do not proceed with fabrication or installation in areas of discrepancy until all such discrepancies are fully resolved.

3.02 FABRICATION

A. General

1. Fabricate all waterslides and structural support systems in strict accordance with Shop Drawings and referenced standards.

B. Use of dissimilar metals in contact shall not be permitted.

3.03 INSTALLATION OF FOOTINGS AND FOUNDATIONS

A. Foundations shall be installed in strict accordance with the Shop Drawings. All supplies, labor, and installation will be the sole responsibility of others and not the responsibility of the slide manufacturer. The waterslide manufacturer will supply hot-dipped galvanized anchor bolts. Install in accordance with manufacturer's structural drawings and instructions.

3.04 INSTALLATION AND SUPPLY OF HYDRAULIC PACKAGE

A. Minimum Required Water Supply

1. Slide A: 42" Open Body Slide = 800-1000 GPM
2. Slide B: 32" Diameter Enclosed Body Slide = 300-500 GPM

3.05 WELDING

A. General

1. For details of joints, comply with requirements for AWS joints accepted without qualification tests.
2. Field welds will not be permitted.
3. Use E-70XX series electrodes.
4. Follow applicable sections of AWS specifications.

3.06 ERECTION

A. General:

1. Erect all fiberglass waterslides and structural support systems in strict accordance with the shop drawings and all pertinent regulations and standards.

B. Tolerance

1. Align all structural steel straight, plumb and level.

C. Fiberglass Joints

1. All flange-to-flange connections shall be made utilizing the waterproof caulking and custom triple layer gasketing system supplied by the fiberglass manufacturer and shall be joined in such a way as to provide for a safe and matless ride. All joints shall be aligned for a completely smooth riding surface, that is, alignment must be within 1/16" and in no case shall the downstream side of the joint above the upstream side of the joint.

D. Steel Finishes

1. All steel components to be hot-dipped galvanized for maximum corrosion protection. Any scarred surfaces shall be cleaned and cold galvanized with zinc rich paint. * See flume structural support system F.1.

3.07 CLEAN-UP

A. Upon completion of the work of this section, immediately remove all fiberglass, debris and rubbish occasioned by this work to the approval of the owner and at no additional cost to the owner.

3.08 OWNER INSTRUCTION

A. Manufacturer shall train Owner's personnel in the operation and maintenance of the waterslide at the job site during pool start-up

END OF SECTION

SECTION 13 24 16
SAUNAS

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes precut saunas.

1.02 RELATED SECTIONS

A. Section 01 31 00 - Project Management and Coordination.

B. Section 01 33 00 - Submittal Procedures.

C. Section 01 40 00 - Quality Requirements.

D. Section 01 60 00 - Product Requirements.

E. Section 01 92 00 - Facility Operation and Maintenance.

F. Section 06 10 00 - Rough Carpentry.

G. Section 06 20 00 - Finish Carpentry.

H. Section 07 21 00 - Thermal Insulation.

I. Section 09 30 00 - Tiling.

1.03 REFERENCES

A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; Current Edition.

B. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood; 2020.

C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. PS 1 - Structural Plywood; 2023.

E. PS 20 - American Softwood Lumber Standard; 2025.

F. WCLIB (GR) - Standard Grading Rules for West Coast Lumber No. 17; 2018.

G. WWPA G-5 - Western Lumber Grading Rules; 2021.

1.04 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Source Limitations: Obtain saunas components through one source from a single manufacturer.

C. Safety Glass: Category II materials complying with testing requirements in 16 CFR 1201.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1, Section - "Project Management and Coordination."

1.05 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, sauna heater rated capacities and effective room volumes, and accessories.

B. Shop Drawings: Include dimensioned plans, elevations, sections, and large-scale details.
   1. Show sauna heater dimensions, mounting location, required clearances, and controls.
   2. Include methods of connection for sauna heater, lighting, and controls.
   3. Show field measurements, locations and sizes of blocking and reinforcements, and attachments to other work.

C. Procurement:

1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
2. Submit inventory to Owner within 5 days of delivery of materials.
3. See Sections 01 33 00 and 01 60 00.

D. Operation and Maintenance Data: Submit O&M manuals according to the requirements of Section 01 92 00 - Facility Operation and Maintenance.

E. Warranty: Special warranty specified in this Section.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store sauna materials and components flat and blocked off the ground.

B. Store saunas in areas where temperature and relative humidity are maintained at occupancy levels.

1.07 PROJECT CONDITIONS

A. Environmental Limitations: Do not install saunas until building is enclosed, wet work in spaces is complete and dry, and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Field Measurements: Verify openings and dimensions for precut saunas by field measurements before fabrication and indicate measurements on Shop Drawings.
1. Locate concealed framing, blocking, and reinforcements that support precut saunas by field measurements before being enclosed and indicate measurements on Shop Drawings.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Airmist, Inc.
2. Helo Sauna & Steam.
3. Scandia Manufacturing.
4. Accurate Industries.

2.02 MATERIALS

A. Wood Species and Grades (WD-7A): Provide lumber of grades indicated according to DOC PS 20 and the ALSC National Grading Rule provisions of the grading agency indicated.
1. Western Red Cedar: WCLIB (GR) or WWPA G-5; Clear Heart.
a. Thickness: 11/16”
b. Width: 5 ½”
c. Length: 12 feet.
d. Finish: Vendor to submit sample to Architect for approval.

B. Softwood Plywood: DOC PS 1.

C. Hardwood Plywood: HPVA HP-1, made with adhesive containing no urea formaldehyde.

D. Fasteners: Stainless steel.

E. Vapor Retarder:
1. See section 09 30 00 - Tiling and drawings for Waterproofing system that functions as a vapor retarder.

2.03 SAUNAS

A. Precut Saunas: Provide manufacturer's standard precut components, and trim; designed for installation over existing framing.

B. Interior Wall and Ceiling Paneling: 1-by-6-inch-nominal (38-by-89-mm-actual), V-joint, tongue-and-groove wood boards of species and grade indicated; sanded smooth; kiln dried to no more than 12 percent moisture content.
1. Wood Species: Western red cedar (WD-7A).

C. Flooring: See Finish Schedule.

D. Benches: Fabricate from S4S, 2-by-6-inch-nominal (38-by-89-mm-actual) wood, spaced not more than 1/4 inch (7 mm) apart and supported by 2-by-4-inch-nominal (38-by-89-mm-actual), 2-by-6-inch-nominal and 4-by-4-inch-nominal wood framing; of same wood species as interior paneling.

2.04 HEATERS AND CONTROLS

A. Sauna Heater: Manufacturer's standard electric convection unit with stainless-steel elements, stainless-steel interior, stainless-steel exterior, and wire protective top grill. Provide heat-tested, shatter-resistant igneous rocks that are in direct contact with and completely cover heating-unit coils.

B. Basis of Design:
   1. Scandia Manufacturing, Model 18208-3.
   2. Or approved equal. See 01 60 00.

C. Requirements:
   1. Capacity:
      a. Sufficient for size of room shown on drawings.
      b. One (1) heater per sauna room if possible. Two (2) heaters to be substituted for large sauna rooms.
   2. Power Supply: 208-V ac, 3-phase.
   3. Mounting: Wall Mounted.
   4. Remote Analog Controls: Manufacturer's standard system designed for surface wall mounting, with thermostat and the following features:
      a. Heater switch.
      b. Light switch.
      c. Heat-indicator light.
      d. Adjustable temperature control.
      e. Temperature Alarm.
      f. Non-programmable.
      g. Electronic controls without analog control components are not acceptable.
      h. Acceptable Manufacturers and Products:
         1) Controller shall be Amerec SC-CLUB controller.
         2) Or approved equal.

2.05 ACCESSORIES

A. Provide the following accessories. Provide wood accessories of same wood species as interior paneling, unless otherwise indicated.
   1. Wood guardrail for heater, of dimensions required by listing.
   2. Wood-slat backrest for each bench.
   3. Thermometer, 4-inch (102-mm) diameter, with chrome casing.

2.06 FABRICATION

A. Fabricate saunas to dimensions, profiles, and details indicated. Sand boards smooth and ease edges to a radius of not less than 1/16 inch (1.6 mm).

B. Shop cut openings, to maximum extent possible, to receive hardware, electrical work, vents, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

C. Nail- or screw- and glue bench components together from bottom side.

D. Countersink or conceal all metal fasteners.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine walls, ceilings, and floors for suitable conditions where saunas are to be installed.

B. Examine roughing-in for electrical systems to verify actual locations of electrical connections before heater installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Condition paneling to average prevailing humidity conditions in installation areas before installation.

3.03 INSTALLATION OF PRECUT SAUNAS

A. Install sauna according to manufacturers' written instructions.

B. Install sauna components level, plumb, true, and straight with no distortions. Shim, as required, with concealed shims. Install level, plumb, and to a true plane to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm). Install with no more than 1/16 inch in 96-inch (1.6 mm in 2400-mm) vertical cup or bow.

C. Install interior paneling vertically and anchor to supporting substrate with blind nailing through tongue and groove. Do not use face fastening. Install with fewest joints possible, using full-length pieces.

3.04 CONNECTIONS

A. Connect electrical power service to power distribution system according to requirements specified in Division 16. Connect according to NFPA 70 and local regulations.

3.05 ADJUSTING

A. Adjust sauna door to close securely without binding. Adjust door to operate at room temperature and at sauna operating temperature.

B. Replace sauna components and exposed paneling that are damaged or do not comply with requirements.

END OF SECTION

SECTION 13 48 13
MANUFACTURED SOUND AND VIBRATION CONTROL COMPONENTS

PART 1 GENERAL

1.01 SUMMARY

A. The work of this section includes:
   1. Types of re-bonded recycled rubber Floating Floor Underlayment to be placed under flooring where sound isolation is indicated on drawings.

1.02 RELATED REQUIREMENTS

A. Section 01 33 00 - Submittal Procedures.

B. Section 01 40 00 - Quality Requirements.

C. Section 01 60 00 - Product Requirements.

D. Section 03 30 00 - Cast-in-Place Concrete.

E. Section 06 10 00 - Rough Carpentry.

F. Section 09 30 00 - Tile.

G. Section 09 64 66 - Wood Athletic Flooring.

H. Section 09 65 19 - Resilient Flooring.

I. Section 09 65 66 - Resilient Athletic Sports Surface.

1.03 REFERENCES

A. Standards listed by reference, including revisions by issuing authority, form a part of this specification section to extent indicated. Standards listed are identified by an issuing authority, authority abbreviation, designation number, title, or other designation established by the issuing authority. Standards subsequently referenced herein are referred to by an issuing authority and standard designation.

B. American Society for Testing and Materials (ASTM):
   1. ASTM E492 - Standard Test Method for Laboratory Measurement of Impact Sound Transmission Through Floor-Ceiling Assemblies Using the Tapping Machine.
   2. ASTM C627 - Standard Test Method for Evaluating Ceramic Floor Tile Installation Systems Using the Robinson-Type Floor Tester.
   3. ASTM E989 - Standard Classification for Determination of Impact Insulation Class. (IIC)
   4. ASTM E1007 - Standard Test Method for Field Measurement of Tapping Machine Impact Sound Transmission Through Floor-Ceiling Assemblies and Associated Support Structures.
   5. ASTM E2179 - Standard Test Method for Laboratory Measurement of the Effectiveness of Floor Coverings in Reducing Impact Sound Transmission Through Concrete Floors.
   6. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
   7. ASTM E336 - Standard Test Method for Measurement of Airborne Sound Insulation in Buildings.
   8. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in-situ Probes.
   9. ASTM D5116 CHPS/CA 01350 - Collaborative of High Performance Schools, Low- Emitting Materials Criteria.
   10. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.

C. South Coast Air Quality Management District (SCAQMD) Rule # 1168
   1. .3.1: VOC standards for adhesive and sealant applications.
   2. Leadership in Energy and Environmental Design – LEED®

D. International Organization for Standardization® document, ISO 14021 – Provides guidance on the terminology, symbols, testing, and verification methodologies that an organization should use for self-declaration of the environmental aspects of its products and services.

1.04 PERFORMANCE REQUIREMENTS

A. Provide recycled rubber resilient flooring, which has been manufactured and installed to maintain performance criteria stated by manufacturer without defects, damage, or failure.

1.05 SUBMITTALS

A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.

B. Product Data: Submit product data, including manufacturer's guide specifications product sheet, for specified products.

C. Shop Drawings: Manufacturer's specifications, catalog cuts, and other items needed to demonstrate compliance with the specified requirements. Also the manufacturer's recommended installation procedures, which, when approved by the architect, will become the basis for accepting or rejecting actual installation procedures used on work.

D. Quality Assurance Submittals: Submit the following:
   1. Certificates: If required, certification of performance characteristics specified in this document shall be provided by the manufacturer.
   2. Manufacturer's Instructions: Manufacturer's installation instructions.

E. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.
   3. See Sections 01 33 00 and 01 60 00.

F. Closeout Submittals: Submit the following:
   1. Warranty: Warranty documents specified herein.

1.06 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Source Quality:
   1. Source Quality: Obtain re-bonded recycled rubber impact sound insulation materials from a single manufacturer

C. Qualifications:
   1. Installer Qualifications: Installer experienced in performing work of this section who has specialized in installation of work similar to that required for this project.
      a. Certificate: When requested, submit certificate indicating qualification.
   2. Manufacturers' Qualifications: Manufacturer capable of approving application method.

D. Regulatory Requirements: As required by AHJ.

E. Pre-installation Meetings: Conduct pre-installation meeting to verify project requirements, substrate conditions, manufacturer's instructions, and manufacturer's warranty requirements. Comply with Division 1 Project Management and Coordination (Project Meetings) Section.
   1. Pre-installation Testing: Conduct pre-installation testing as required by acoustical consultant.

1.07 DELIVERY, STORAGE, AND HANDLING

A. General: Comply with Division 1 Product Requirements Sections.

B. Ordering: Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.

C. Delivery: Deliver materials in manufacturer's original, unopened, and undamaged containers with identification labels intact.

D. Storage and Protection: Store materials at temperature and humidity conditions recommended by manufacturer and protect from exposure to harmful weather conditions.

1.08 PROJECT CONDITIONS

A. Temperature Requirements: Maintain air temperature in spaces where products will be installed for time period before, during, and after installation as recommended by manufacturer.

B. Field Measurements: Verify actual measurements/openings by field measurements before fabrication; show recorded measurements on shop drawings. Coordinate field measurements and fabrication schedule with construction progress to avoid construction delays.

1.09 WARRANTY

A. Project Warranty: Refer to Conditions of the Contract for project warranty provisions.
   1. Provide Limited Lifetime Warranty as provided by product manufacturer.
   2. Provide 1 year workmanship warranty by product installer.

PART 2 PRODUCTS

2.01 MANUFACTURER:

A. Pliteq Inc.
   1. Address: 131 Royal Group Crescent, Vaughan, ON L4H 1X9; Telephone: (416) 449-0049;
      a. Fax: (416) 849-0415; Email: info@pliteq.com

2.02 PRODUCTS

A. Pliteq FF50 Re-Bonded Recycled Rubber Floating Floor Underlayment.
   1. Sheet Dimension: overall nominal thickness of 2" standard in 4' by 15' roll size.
      a. Sheet Weight: 4.4 lb/ft^2
   2. Testing Standards:
      a. Dimensional Tolerances are pursuant to ISO 3302-1.
      b. Impact Insulation Class Laboratory (ASTM E492): Specified floor-ceiling assembly must be tested in a NVLAP certified laboratory and comply with ASTM standards.
      c. Impact Insulation Class Field (ASTM E1007): Floor-ceiling assembly must meet requirement as stated by building code and/or acoustical consultant.
      d. Reduced Impact Sound transmission (ASTM E2179): Specified floor-ceiling assembly must be tested in a NVLAP certified laboratory and comply with ASTM standards.
      e. Sound Transmission Class Laboratory (ASTM E90): Specified floor-ceiling assemble must be tested in a NVLAP certified laboratory and comply with ASTM standards.

B. Pliteq GenieMat PMI12PF Polyethylene Foam Perimeter Isolation Strip.
   1. Polyethylene foam, flat, resilient strip that is used to build a tub around the floor so that no hard surface (floor covering) touches any hard vertical surface (protrusion or wall).
   2. Sheet Dimension: overall nominal thickness of 1/2" [nom. 12 mm] in 6" by 50' [nom. 0.15 m by 15.2 m] roll size.
   3. Sheet Weight: overall weight of 0.07 lb/ft^2 [0.34 kg/m^2]

C. Polyethylene Sheeting:
   1. Minimum 6 mil thickness.

D. Related Materials:
   1. Related Materials: Refer to other sections listed in Related Sections paragraph herein for related materials.

PART 3 EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

A. Compliance: Comply with manufacturer's product data, including product technical bulletins, product catalog installation instructions, and product carton instructions for installation.

3.02 EXAMINATION

A. Site Verification of Conditions: Verify substrate conditions, which have been previously installed under other sections, are acceptable for product installation in accordance with manufacturer's instructions.

3.03 PREPARATION

A. Surface Preparation: Surfaces shall be prepared in accordance with ANSI standards.

3.04 ERECTION/INSTALLATION/APPLICATION/CONSTRUCTION

A. Re-bonded Recycled Rubber Floating Floor Underlayment: Comply with the Manufacturer's Technical Installation Manual for procedures and techniques for re-bonded recycled rubber Floating Floor Underlayment installation.

B. Related Products Installation: Refer to other sections listed in Related Sections paragraph herein for related products installation.

C. Installation should not begin until all other trades are finished in the area.

D. Areas to receive the re-bonded recycled rubber Sound Control Underlayment should be weather tight and maintained at a minimum uniform temperature of 65F (18C) for 48 hours before, during, and after the installation.

3.05 FIELD QUALITY REQUIREMENTS

A. Manufacturer's Field Services: Upon Owner's request, provide manufacturer's field service consisting of product use recommendations in accordance with manufacturer's instructions.

B. Field Tests should be performed by an independent acoustical laboratory accredited by the U.S. Department of Commerce, National Institute of Standards and Technology under the National Voluntary Laboratory Accreditation Program for the specified test procedure.

C. The cost for all field acoustical testing, corrective work associated with the installation of the re-bonded recycled rubber Floating Floor Underlayment and flooring to meet the minimum requirements, shall be borne by the flooring contractor(s).

3.06 CLEANING

A. Remove temporary coverings and protection of adjacent work areas. Repair or replace damaged installed products. Clean installed products in accordance with manufacturer's instructions prior to Owner's acceptance. Remove construction debris from project site and legally dispose of debris.

3.07 PROTECTION

A. Protection: Protect installed product and finish surfaces from damage during construction.

END OF SECTION

SECTION 14 08 00
COMMISSIONING OF CONVEYING SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. This section includes specific requirements that apply to the implementation of the Commissioning Process and this Division Contractors' participation in this process. This section details the project specific equipment and systems that are included in the Commissioning Process. For general descriptions and responsibilities, refer to SECTION 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

1.02 RELATED DOCUMENTS

A. The Owner's Project Requirements (OPR) document.

B. The Basis of Design (BoD) document.

C. The Project Commissioning Plan (CxP) document.

D. ASHRAE Standard 202-2013 - Commissioning Process for Buildings and Systems.

E. LEED v4 for Building Design and Construction.

1.03 RELATED SECTIONS

A. SECTION 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS

B. SECTION 07 08 00 - COMMISSIONING OF THERMAL AND MOISTURE PROTECTION

C. SECTION 08 08 00 - COMMISSIONING OF OPENINGS

D. SECTION 11 08 00 - COMMISSIONING OF EQUIPMENT

E. SECTION 13 08 00 - COMMISSIONING OF SPECIAL CONSTRUCTION

F. SECTION 21 08 00 - COMMISSIONING OF FIRE SUPPRESSION SYSTEMS

G. SECTION 22 08 00 - COMMISSIONING OF PLUMBING SYSTEMS

H. SECTION 23 08 00 - COMMISSIONING OF MECHANICAL SYSTEMS

I. SECTION 25 08 00 - COMMISSIONING OF INTEGRATED AUTOMATION SYSTEMS

J. SECTION 26 08 00 - COMMISSIONING OF ELECTRICAL SYSTEMS

K. SECTION 27 08 00 - COMMISSIONING OF COMMUNICATIONS SYSTEMS

L. SECTION 28 08 00 - COMMISSIONING OF SAFETY AND SECURITY SYSTEMS

M. SECTION 33 08 00 - COMMISSIONING OF UTILITIES

1.04 DEFINITIONS

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

1.05 RESPONSIBILITIES

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

PART 2 PRODUCTS

2.01 NO PRODUCTS SUPPLIED

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

B. Contractors and/or Vendors shall provide the specialty testing equipment necessary to fulfill the functional testing requirements, for the duration of the testing period.

PART 3 EXECUTION

3.01 GENERAL

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.02 MEETINGS

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.03 SYSTEM START-UP

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.04 PRE-FUNCTIONAL CHECKLISTS

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.05 FUNCTIONAL PERFORMANCE TESTING

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.06 TRAINING

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.07 SYSTEMS TO BE COMMISSIONED

A. GENERAL
   1. Commissioning specifications supplement the requirements of individual specifications sections but shall not be interpreted to replace or diminish the specified scope of any individual section.
   2. For all systems listed below, Division Contractor shall comply with all commissioning requirements specified.

B. APPLICABLE SYSTEMS
   1. Passenger Elevators
   2. Wheelchair Lifts

END OF SECTION

SECTION 14 21 50
MRL ELECTRIC TRACTION ELEVATORS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: Machine Room-Less Electric Traction Elevators.

B. Products Supplied but Not Installed Under this Section:
   1. Hoist Beam.
   2. Pit Ladder.
   3. Inserts mounted in block walls for rail attachments.

1.02 RELATED SECTIONS

A. Section 01 31 00 - Project Management and Coordination.

B. Section 01 33 00 - Submittal Procedures.

C. Section 01 40 00 - Quality Requirements.

D. Section 01 60 00 - Product Requirements.

E. Section 03 30 00 - Cast-in-Place Concrete.

F. Section 04 20 00 - Unit Masonry.

G. Section 05 50 00 - Metal Fabrications.

H. Section 06 10 00 - Rough Carpentry.

I. Section 07 14 50 - Fluid Applied Waterproofing Membrane.

J. Section 07 81 00 - Applied Fireproofing.

K. Division 23 - Heating, Ventilating, and Air Conditioning.

L. Division 26 - Electrical.

M. Division 27 - Communications.

N. Division 28 - Electronic Safety and Security.

O. Division 31 - Earthwork.

1.03 DEFINITIONS

A. Defective Elevator Work: Operation or control system failures; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; the need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected and unsatisfactory conditions.

1.04 REFERENCE STANDARDS

A. ADAAG - Americans With Disabilities Act Accessibility Guidelines; 2010.

B. ASME A17.1 - Safety Code for Elevators and Escalators Includes Requirements for Elevators, Escalators, Dumbwaiters, Moving Walks, Material Lifts, and Dumbwaiters with Automatic Transfer Devices; 2022.

C. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2023a.

D. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes; 2024.

E. ASTM A554 - Standard Specification for Welded Stainless Steel Mechanical Tubing; 2021.

F. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2023, with Editorial Revision.

G. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.

H. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

I. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.

J. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2020.

K. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

L. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

M. ISO 9001 - Quality Management Systems — Requirements; 2015, with Amendment (2024).

N. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

O. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

P. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2025.

Q. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2022.

R. UL 10B - Standard for Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

S. UL 62 - UL Standard for Safety Flexible Cords and Cables; Current Edition.

T. UL 2556 - UL Standard for Safety Wire and Cable Test Methods; Current Edition.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination of Work:
   1. Elevator Installer is required to coordinate with the installers/providers of all related work, prior to the commencement of any elevator work or related work.
      a. Submit and coordinate Shop Drawings with other trades so that elevator pit, supports, electrical, mechanical and other trades can accomodate the specific type and model of elevator to be installed.
   2. Coordinate installation of sleeves, block outs, and items that are embedded in concrete or masonry for elevator equipment. Furnish templates and installation instructions and deliver to Project site in time for installation.
   3. Coordinate sequence of elevator installation with other Work to avoid delaying Work.
   4. Coordinate locations and dimensions of other Work relating to hydraulic elevators including pit ladders, sumps, and floor drains in pits; entrance subsills; and electrical service, electrical outlets, lights, and switches in pits and machine rooms.
   5. Pre Installation Conference:
      a. Hold a Pre-Construction Conference, to include GC, Architect, Mechanical and Electrical Engineers, Elevator Installer, and the Installers of related work, prior to the commencement of work.
      b. Conduct conference according to the requirements of 01 31 00.

1.06 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with ASME A17.1.

B. Accessibility Requirements: Comply with Section 407 in the U.S. Architectural & Transportation Barriers Compliance Board's ADAAG Accessibility Guidelines and with ICC A117.1.

C. Car Performance:
   1. Car Speed ± 5% of contract speed under any loading condition or direction of travel.
   2. Car Capacity: Safely lower, stop and hold (per code) up to 125% of rated load.

D. System Performance:
   1. Horizontal Vibration (maximum): ISO 18738/ISO 8041 system pk-pk 12 mg

2. Jerk Rate (maximum): 1 m/s^3
3. Acceleration (maximum): 0.4 m/s^2
4. In Car Noise: 55 dB(A) Maximum
5. Leveling Accuracy: ±0.2 inches
6. Starts per hour (maximum): 180

1.07 SUBMITTALS

A. Comply with Section 01 33 00 - Submittal Procedures.

B. Product Data: Submit manufacturer's product literature for each proposed system.
1. Cab design, dimensions and layout.
2. Layout, finishes, and accessories and available options.
3. Controls, signals and operating system.
4. Color selection charts for cab and entrances.

C. Shop Drawings:
1. Clearances and travel of car.
2. Clear inside hoistway and pit dimensions.
3. Location and layout of equipment and signals.
4. Car, guide rails, buffers and other components in hoistway.
5. Maximum rail bracket spacing.
6. Maximum loads imposed on building structure.
7. Hoist beam requirements.
8. Location and sizes of access doors.
9. Location and details of hoistway door and frames.
10. Electrical characteristics and connection requirements.

D. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoistway, pit, and machine room layout and dimensions, as shown on Drawings, and electrical service, as shown and specified, are adequate for elevator system being provided.

E. Manufacturer's and Installer's qualifications.

F. Operation and maintenance Data:
1. Provide manufacturer's standard maintenance and operation manual.

G. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.

H. Diagnostic Tools:
1. Prior to seeking final acceptance for the completed project as specified by the Contract Documents, the Elevator Contractor shall deliver to Life Time any specialized tool(s) that may be required to perform diagnostic evaluations, adjustments, and/or parametric software changes and/or test and inspections on any piece of control or monitoring equipment installed.
    a. This shall include any specialized tool(s) required for monitoring, inspection and/or maintenance where the means of suspension other than conventional wire ropes are furnished and installed by the Elevator Contractor. Any and all such tool(s) shall become property of Life Time. Any diagnostic tool provided to Life Time by the Elevator Contractor shall be configured to perform all levels of diagnostics, systems adjustment and parametric software changes which are available to the Elevator Contractor.
    b. In those cases where diagnostic tools provided to Life Time require periodic recalibration/or re-initiation, the Elevator Contractor shall perform such tasks at no additional cost to the Life Time for a period equal to the term of the maintenance agreement from the date of final acceptance of the competed project. During those intervals in which the Life Time might find it necessary to surrender a diagnostic tool for re-calibration, re-initiation, or repair, the Elevator Contractor shall provide a temporary replacement for the tool at no additional cost to Life Time.
    c. The Elevator Contractor shall deliver to Life Time, printed instructions for the proper use of any tool that may be necessary to perform diagnostic evaluations, system adjustment,

and/or parametric software changes on any unit of microprocessor-based elevator control equipment and means of suspension other than standard elevator steel cables furnished and install by the Elevator Contractor.

d. Accompanying the printed instructions shall be any and all access codes, password, or other proprietary information that is necessary to interface with the microprocessor-control equipment.

I. Warranty: Special warranty specified in this Section.

J. Continuing Maintenance Proposal: Service agreement specified in this Section.

1.08 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Manufacturer: Minimum of fifteen years' experience in the fabrication, installation and service of elevators of the type and performance of the specified.

1. The manufacturer shall have a documented, on-going quality assurance program.
   a. ISO 9001:2000 Manufacturer Certified.

C. Installer Qualifications: Elevator manufacturer or manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

D. Source Limitations: Obtain elevators through 1 source from single manufacturer.

1. Provide major elevator components, including pump-and-tank units, plunger-cylinder assemblies, controllers, signal fixtures, door operators, car frames, cabs, and entrances, manufactured by single manufacturer.

E. Regulatory Requirements:

1. Comply with the following regulations and standards:
   a. ASME A17.1
   b. Building Code: ICC As adopted by the AHJ.
   c. NFPA 70 National Electrical Code.
   d. NFPA 80 Fire Doors and Windows.
   e. Americans with Disabilities Act - Accessibility Guidelines (ADAAG)
2. Effective peak velocity acceleration (Av) for Project's location is less than 0.10 (seismic risk zones 0 and 1).
3. Project's seismic design category is D unless indicated otherwise in structural Documents.
4. Elevator importance factor is 1.0.

F. Accessibility Requirements: Comply with Section 4.10 in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)" and 407 in ICC A117.1.

G. Fire-Rated Hoistway Entrance Assemblies: Door and frame assemblies complying with NFPA 80 that are listed and labeled by testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing at as close to neutral pressure as possible per NFPA 252 or UL 10B.

H. Inspection and testing:

1. Elevator Installer shall obtain and pay for all required inspections, tests, permits and fees for elevator installation.
2. Deliver to the Owner upon completion and acceptance of elevator work.

1.09 DELIVERY, STORAGE AND HANDLING

A. If the construction site is not prepared to receive the elevator equipment at the agreed ship date, the General Contractor shall be responsible to provide a safe, dry, and easily accessible storage area on or off the premises. Additional labor costs for double handling will be the responsibility of the general contractor.

B. Delivered elevator materials shall be stored in a protected environment in accordance with manufacturer recommendations. A minimum storage area of 10 feet by 20 feet is required adjacent to the hoistway.

1.10 PROJECT CONDITIONS

A. Temporary Use: Elevators shall not be used for temporary service or for any other purpose during the construction period before Substantial Completion and acceptance by the purchaser unless agreed upon by Elevator Contractor and General Contractor with signed temporary agreement.

1.11 WARRANTY

A. General Warranty: The elevator warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to and run concurrent with, other warranties made by the elevator Contractor under requirements of the Contract Documents.

B. Special Manufacturer's Warranty: Manufacturer's standard form in which manufacturer agrees to repair, restore, or replace defective elevator Work within specified warranty period.
   1. Warranty Period: 1 year from date of Substantial Completion.

1.12 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, provide 1 year's full maintenance service by skilled employees of elevator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in manufacture and installation of original equipment.
   1. Perform maintenance, including emergency callback service, during normal working hours.
   2. Include 24-hour-per-day, 7-day-per-week emergency callback service.
      a. Response Time: 2 hours or less.

B. Continuing Maintenance Proposal: Provide continuing maintenance proposal from Installer to Owner, in form of standard 1 year maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. Provide AC gearless machine room-less elevator systems subject to compliance with the design and performance requirements of this specification. Elevator manufacturers may include but are not limited to one of the following:
   1. Basis of Design: KONE MonoSpace 300® traction elevators by KONE, Inc. (www.kone.com).
   2. ThyssenKrupp Elevator.
   3. Otis Elevator Company.
   4. Or approved equal.

2.02 MACHINE ROOM-LESS ELECTRIC TRACTION ELEVATOR

A. Elevator System, General: Manufacturer's standard elevator systems. Unless otherwise indicated, manufacturers' standard components shall be used, as included in standard elevator systems and as required for complete system.

B. Elevator Description:
   1. Elevator Equipment: KONE MonoSpace 300® gearless traction elevator, or equal.
   2. Equipment Control: KCM831, or equal.
   3. Drive: Non-regenerative.
   4. Rated Load: 3,500 lb.
   5. Rated Speed: 100 FPM.
   6. Auxiliary Operations:
      a. Battery Powered Lowering.
   7. Number of Stops: As indicated on Drawings.

8. Travel Distance: As indicated on Drawings.
9. Car Enclosures:
    a. Inside Width: 80 inches (2057 mm) from side wall to side wall.
    b. Inside Depth: 65 inches (1308 mm) from back wall to front wall (return panels).
    c. Overall Cab Height: 96 inches (2438 mm).
    d. Front Walls (Return Panels): Satin stainless steel, No. 4 finish with integral car door frames.
    e. Car Fixtures: Satin stainless steel, No. 4 finish.
    f. Side and Rear Wall Panels: Plastic laminate, to be selected by Architect from Manufacturer's full range of standard colors.
    g. Ceiling: Suspended Ceiling, satin stainless steel, No. 4 finish with round LED spotlights.
    h. Door Faces (Interior): Satin stainless steel, No. 4 finish.
    i. Handrails: 1/2 by 2 inches (13 by 50 mm) rectangular satin-polished stainless steel, No. 4 finish, at sides and rear of car.
    j. Floor prepared to receive finishes shown on drawings. See Finish Plans.
    k. Base, frieze and reveal package No. 4 stainless steel.
10. Hoistway Entrances:
    a. Number of Openings: 1; front.
    b. Door Type: Front Single Speed Opening:
        1) Right Hand Door or Left Hand Door as indicated on Drawings.
    c. Clear Opening Width: 42 inches (1219 mm).
    d. Height: 84 inches (2134 mm).
    e. Type: Single-speed side sliding.
    f. Fire-Protection Rating: As indicated on Drawings.
    g. Frames: Satin stainless steel, No. 4 finish.
    h. Doors: Satin stainless steel, No. 4 finish.
    i. Sills: Aluminum, mill finish.
11. Hall Fixtures: Satin stainless steel, No. 4 finish.
12. Additional Requirements:
    a. Provide inspection certificate in each car, mounted under acrylic cover with frame made from satin stainless steel, No. 4 finish.
    b. Provide blanket hooks and 2 complete set(s) of full-height protective blankets.

2.03 SYSTEMS AND COMPONENTS

A. Means of Suspension:
    1. Provide Non-combustible means of suspension, meeting the requirements of UL 62, UL 2556 (FT-1) and ASME A17.1. Provide one of the following:
        a. Traditional hoist cables with Wedge Style Shackles or approved means under the code.
        b. Fire rated assembly consisting of metal cables sheathed in non-circular polyurethane jacket.
        c. Other means approved by Architect and AHJ.

B. Hoistway Components:
    1. Machine: AC gearless machine, with permanent magnet synchronous motor, direct current electro-mechanical disc brakes and integral traction drive sheave, mounted to the car guide rail at the top of the hoistway.
    2. Drive: Provide Variable Voltage Variable Frequency AC drive system to develop high starting torque with low starting current.
    3. Car Guides: Provide guide-shoes mounted to top and bottom of both car and counterweight frame. Each guide-shoe assembly shall be arranged to maintain constant contact on the rail surfaces. Provide retainers in areas with Seismic design requirements.

2.04 OPERATIONS SYSTEMS

A. Controller: Provide microcomputer based control system to perform all of the functions.
    1. All high voltage (110V or above) contact points inside the controller cabinet shall be protected from accidental contact in a situation where the controller doors are open.

2. Controller shall be separated into two distinct halves; Motor Drive side and Control side. High voltage motor power conductors shall be routed and physically segregated from the rest of the controller.
3. Provide a serial cardrack and main CPU board containing a non-erasable EPROM and operating system firmware.
4. Variable field parameters and adjustments shall be contained in a non-volatile memory module.

B. Controller Location: Locate controller[s] in the front wall integrated with the top landing entrance frame, machine side of the elevator. One non-fused three phase permanent power in hoist way at top landing. A separate control space should not be required.

C. Elevator Operation:
1. Simplex Collective Operation: Using a microprocessor-based controller, operation shall be automatic by means of the car and hall buttons. If all calls in the system have been answered, the car shall park at the last landing served.
2. Zoned Car Parking.
3. Relative System Response Dispatching.

D. Standard Operating Features to include:
1. Full Collective Operation.
2. Fan and Light Control.
3. Load Weighing Bypass.
4. Ascending Car Uncontrolled Movement Protection.
5. Top of Car Inspection Station.

E. Additional Operating Features to include:
1. Elevator Control System for Inspections and Emergency.
   a. Provide devices within controller to run the elevator in inspection operation.
   b. Provide devices on car top to run the elevator in inspection operation.
   c. Provide within controller an emergency stop switch to disconnect power from the brake and prevents motor from running.
   d. Provide the means from the controller to mechanically lift and control the elevator brake to safely bring car to nearest available landing when power is interrupted.
   e. Provide the means from the controller to reset the governor over speed switch and also trip the governor.
   f. Provide the means from the controller to reset the emergency brake when set because of an unintended car movement or ascending car over speed.
   g. Provide the means for the control to reset elevator earthquake operation.
2. Emergency Communication System: 2-way voice communication system, with visible signal, which dials preprogrammed number of monitoring station and does not require handset use. System is contained in flush-mounted cabinet, with identification, instructions for use, and battery backup power supply.
   a. Provide Video communication where required by AHJ.
3. Security Features: In addition to above operational features, provide the following security features, where indicated. Security features shall not affect emergency firefighters' service.
   a. Security Camera / Video Capability: Provide wiring terminated on car top in a junction box clearly marked “camera” on the junction box cover located on the opposite corner of the car operating panel. Coordinate with work of Div 28.
4. Auxiliary Operations: In addition to primary operation system features, provide the following operational features for elevators:
   a. Battery-Powered Lowering: When power fails, car is lowered to the lowest floor, opens its doors and shuts down. System includes rechargeable battery and automatic recharging system.

2.05 HOISTWAY ENTRANCES

A. Doors and Frames: Provide complete hollow metal type hoistway entrances at each hoistway opening boltedknock down construction.

1. Manufacturer's standard entrance design consisting of hangers, doors, hanger supports, hanger covers, fascia plates (where required), sight guards, and necessary hardware.
2. Main landing door & frame finish: ASTM A1008/A1008M steel panels, factory applied powder coat finish with factory-applied powder coat finish entrance frame.
3. Typical door & frame finish: ASTM A1008/A1008M steel panels, factory applied powder coat enamel finish with factory-applied powder coat finish entrance frame.

B. Door Hanger and Tracks: Provide sheave type two point suspension hangers and tracks for each hoistway horizontal sliding door.
1. Sheaves: Polyurethane tires with ball bearings properly sealed to retain grease.
2. Hangers: Provide an adjustable device beneath the track to limit the up-thrust of the doors during operation.
3. Tracks: Drawn steel shapes, smooth surface and shaped to conform to the hanger sheaves.

C. Hoistway Sills: Extruded metal, with groove(s) in top surface. Provide mill finish on aluminum.

2.06 CAR ENCLOSURES

A. General: Provide steel-framed car enclosures with nonremovable wall panels, car roof, access doors, power door operators, and ventilation.
1. Provide standard railings complying with ASME A17.1/CSA B44 on car tops where required by ASME A17.1/CSA B44.
2. Provide finished car including materials and finishes specified below.

B. Materials and Finishes: Provide manufacturer's standards, but not less than the following:
1. Subfloor: Underlayment grade, exterior plywood, 5/8 inch (16 mm) nominal thickness.
2. Floor Finish: Specified in Division 09.
3. Stainless-Steel Wall Panels: Flush, hollow-metal construction; fabricated from stainless-steel sheet.
4. Plastic-Laminate Wall Panels: Plastic laminate adhesively applied to 1/2 inch (13 mm) fire-retardant-treated particleboard with plastic-laminate panel backing and manufacturer's standard protective edge trim. Panels have flame-spread index of 25 or less, when tested per ASTM E84.
   a. Color to be selected by Architect from Manufacturer’s full range of standard colors.
5. Fabricate car with recesses and cutouts for signal equipment.
6. Fabricate car door frame integrally with front wall of car.
7. Stainless-Steel Doors: Flush, hollow-metal construction; fabricated from stainless-steel sheet or by laminating stainless-steel sheet to exposed faces and edges of enameled cold-rolled steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning.
8. Sight Guards: Provide sight guards on car doors.
9. Sills: Extruded aluminum, with grooved surface, 1/4 inch (6.4 mm) thick.
10. Handrails: Manufacturer's standard stainless-steel handrails, of shape, metal, and finish indicated.
11. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M.

C. Car Frame: Provide car frame with adequate bracing to support the platform and car enclosure.
1. Platform: Platform shall be all steel construction.
2. Steel Cab.

D. Emergency Car Signals:
1. Emergency Siren: Siren mounted on top of cab that is activated when the alarm button in the car operating panel is engaged. Siren shall have rated sound pressure level of 80 dB(A) at a distance of three feet from device. Siren shall respond with a delay of not more than one second after activation of alarm button.
2. Emergency Car Lighting: Provide emergency power unit employing a 12- volt sealed rechargeable battery and totally static circuits shall illuminate the elevator car and provide current to the alarm bell in the event of building power failure.
3. Emergency Exit Contact: An electrical contact shall be provided on the car-top exit.

E. Ventilation: Fan.

2.07 DOOR OPERATION

A. Door Operator: A closed loop permanent magnet VVVF high-performance door operator shall be provided to open and close the car and hoistway doors simultaneously. Door movement shall be cushioned at both limits of travel. Electro-mechanical interlock shall be provided at each hoistway entrance to prevent operation of the elevator unless all doors are closed and locked. An electric contact shall be provided on the car at each car entrance to prevent the operation of the elevator unless the car door is closed.

B. The door operator shall be arranged so that, in case of interruption or failure of electric power, the doors can be readily opened by hand from within the car, in accordance with applicable code. Emergency devices and keys for opening doors from the landing shall be provided as required by local code.

C. Doors shall open automatically when the car has arrived at or is leveling at the respective landings. Doors shall close after a predetermined time interval or immediately upon pressing of a car button. A door open button shall be provided in the car. Momentary pressing of this button shall reopen the doors and reset the time interval.

D. Door hangers and tracks shall be provided for each car and hoistway door. Tracks shall be contoured to match the hanger sheaves. The hangers shall be designed for power operation with provisions for vertical and lateral adjustment. Hanger sheaves shall have polyurethane tires and pre-lubricated sealed-for-life bearings.

E. Electronic Door Safety Device. The elevator car shall be equipped with an electronic protective device extending the full height of the car. When activated, this sensor shall prevent the doors from closing or cause them to stop and reopen if they are in the process of closing. The doors shall remain open as long as the flow of traffic continues and shall close shortly after the last person passes through the door opening.

2.08 SIGNAL EQUIPMENT

A. Car Operating Panel: Provide car operating panel with all push buttons, key switches, and message indicators for elevator operation. Fixture finish to be: Brushed Stainless Steel.
   1. Main Flush mounted car operating panel shall contain a bank of round, mechanical, illuminated buttons marked to correspond to landings served, emergency call button, door open button, door close button, and key switches for lights, inspection, and exhaust fan. Buttons have Amber Dot Matrix illumination (halo). All buttons to have raised text and Braille marking on left hand side. The car operating display panel shall be Amber Dot Matrix. All texts, when illuminated, shall be Amber Dot Matrix. The car operating panel shall have a Brushed Stainless Steel finish.
   2. Additional features of car operating panel shall include:
      a. Car Position Indicator within operating panel.
      b. Elevator Data Plate marked with elevator capacity and car number on car top.
      c. Help buttons with raised markings.
      d. In car stop switch per local code.
      e. Call Cancel Button.

B. Hall Stations:
   1. Provide Hall Stations on wall at location indicated on drawings.
   2. Buttons shall illuminate to indicate call has been registered at that floor for the indicated direction.
   3. Provide one pushbutton riser with faceplates having a brushed stainless steel finish.
      a. Phase 1 firefighter's service key switch, with instructions, shall be incorporated into the hall station at the designated level.
   4. Floor Identification Pads: Provide door jamb pads at each floor. Jamb pads shall comply with Americans with Disabilities Act (ADA) requirements.

C. Car Lantern and Chime: A directional lantern shall be provided. Lantern shall be mounted on wall at location indicated on drawings. When the car stops and the doors are opening, the lantern shall

indicate the direction in which the car is to travel and a chime will sound. The chime will sound once for up and twice for down. The car riding lantern face plate shall have a Brushed Stainless Steel finish.

2.09 FINISH MATERIALS

A. General: Provide the following materials for exposed parts of elevator car enclosures, car doors, hoistway entrance doors and frames, and signal equipment as indicated.
   1. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, commercial steel, Type B, exposed, matte finish.
   2. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, commercial steel, Type B, pickled.
   3. Stainless-Steel Sheet: ASTM A240/A240M, Type 304.
   4. Stainless-Steel Bars: ASTM A276/A276M, Type 304.
   5. Stainless-Steel Tubing: ASTM A554, Grade MT 304.
   6. Aluminum Extrusions: ASTM B221 (ASTM B221M), Alloy 6063.
   7. Plastic Laminate: High-pressure type complying with NEMA LD 3, Type HGS or HGL.

PART 3 EXECUTION

3.01 EXAMINATION

A. Field measure and examine substrates, supports, and other conditions under which elevator work is to be performed.

B. Prior to start of Work, verify the following:
   1. Hoistway is in accordance with shop drawings, and within Manufacturer's construction tolerances.
   2. Projections greater than 2 inches (4 inches if ASME A17.1/CSA B44 2000 applies) are beveled not less than 75 degrees from horizontal.
   3. Landings have been prepared for entrance sill installation. Traditional sill angle or concrete sill support shall not be required.
   4. Elevator pit has been constructed in accordance with requirements, is dry and reinforced to sustain vertical forces, as indicated in approved submittal. Verify that sumps or sump pumps located within pit will not interfere with installed elevator equipment.
   5. Control space has been constructed in accordance with requirements, with access coordinated with elevator shop drawings, including Sleeves and penetrations.
   6. Installation of GFCI protected 20-amp in pit and adjacent to each signal control cabinet in control space.

C. For the record, prepare written report, endorsed by Installer, listing dimensional discrepancies and conditions detrimental to performance or indicating that dimensions and conditions were found to be satisfactory.

D. Do not proceed with work until unsatisfactory conditions are corrected.

3.02 PREPARATION

A. Coordinate installation of blocking and temporary protective closures. See Section 06 10 00.

B. Coordinate installation of anchors, bearing plates, brackets and other related accessories. See Section 05 50 00.

C. Coordinate installation of fireproofing. See Section 07 81 00.

D. Coordinate installation of power, temporary lighting, and temporary power. See Division 26.

E. Coordinate installation of hoistway ventilation. See Division 24.

3.03 INSTALLATION

A. Install equipment, guides, controls, car and accessories in accordance with manufacturer installation methods and recommended practices.

B. Properly locate guide rails and related supports at locations in accordance with manufacturer’s recommendations and approved shop drawings. Anchor to building structure using isolation system to minimize transmission of vibration to structure.

C. All hoistway frames shall be securely fastened to fixing angles mounted in the hoistway. Coordinate installation of sills and frames with other trades.

D. Lubricate operating system components in accordance with manufacturer recommendations.

E. Perform final adjustments, and necessary service prior to substantial completion.

F. Interface with Other Work:
   1. Guide rail brackets attached to steel shall be installed prior to application of fireproofing.
   2. Coordinate construction of entrance walls with installation of door frames and sills. Maintain front wall opening until elevator equipment has been installed.
      a. Ensure adequate support for entrance attachment points at all landings.
      b. Coordinate wall openings for hall push buttons, signal fixtures and sleeves. Each elevator requires sleeves within the hoistway wall.
      c. Coordinate emergency power transfer switch and power change pending signals as required for termination at the primary elevator signal control cabinet in each group.
      d. Coordinate interface of elevators and fire alarm system.
      e. Coordinate interface of dedicated telephone line.

3.04 FIELD QUALITY CONTROL

A. Acceptance Testing: On completion of elevator installation and before permitting use (either temporary or permanent) of elevators, perform acceptance tests as required and recommended by ASME A17.1 and by governing regulations and agencies.

B. Advise Owner, Architect, and Authorities having jurisdiction in advance of dates and times tests are to be performed on elevators.

C. Obtain required permits and provide originals to Construction Manager.

3.05 DEMONSTRATION

A. Engage factory-authorized service representative to train Owner's maintenance personnel to operate, adjust, and maintain elevator(s).

B. Check operation of elevator with Owner's personnel present and before date of Substantial Completion. Determine that operation systems and devices are functioning properly.

C. Prior to substantial completion, instruct Construction Manager on the proper function and required daily maintenance of elevators. Instruct personnel on emergency procedures.

D. Check operation of elevator with Owner's personnel present not more than 1 month before end of warranty period. Determine that operation systems and devices are functioning properly.

END OF SECTION

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SECTION 210100 – GENERAL PROVISIONS FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.1 CONDITIONS OF THE CONTRACT

A. The General and Supplementary General Conditions as previously detailed along with the general requirements listed in Division 1 shall apply to all work of this Division.

B. Refer to all other sections if in doubt as to which contractor is to furnish certain materials or labor. Notify Engineer whenever there is an omission, or ambiguity in plans or specifications before bids are turned in.

C. This Contractor will be required to furnish all materials and labor for a complete job if the Engineer is not informed of an omission before bids are received. Mentioned in specifications or shown on plans is sufficient notification for a contractor to furnish material or labor for this job.

1.2 SCOPE

A. The work covered by this division of the specifications and accompanying drawings shall be included in one or multiple sub-contracts as coordinated with the General Contractor and shall encompass the following systems:
   1. Wet-pipe fire sprinklers.
   2. Refer to the following for additional requirements.
      a. Bidding Requirements, Contract Forms and conditions of the Contract (Division 0)
      b. General Requirements (Division 1)
      c. Geotechnical Investigation (Section 00 31 00)
   3. The Scope of Work for each of these systems shall be further defined within the limits of the appropriate section.
   4. Sections numbered 21 01 00 thru 21 05 00 shall apply to any and all separate Fire-Suppression contracts as well as those sections and articles of particular concern.

1.3 CONTRACTOR RESPONSIBILITIES

A. CODES
   1. This work shall be installed in conformity with applicable local ordinances and state statutes. All requirements of the current local amendments, 2021 International Building Code, 2021 International Fire Code, and NFPA 13 (2019) bulletins must be met. Standards and sizes which meet or exceed the above mentioned requirements shall be installed as drawn or specified. Nothing in the specifications or drawings shall be construed to permit deviation from the requirements of governing codes. This Contractor is required to acquire current amendments and make all necessary alternations to the plans in order to meet code.
   2. Submit installation drawings to local Authority Having Jurisdiction (AHJ) for plan review and approval before sprinkler piping is fabricated. Any change/revision to the

piping fabrication is at the cost of the sprinkler contractor. System bid and installed system shall meet all NFPA-13, 2021 International Fire Code, and Utah amendment requirements, including head quantities and locations.

B. PERMITS/ INSPECTIONS/ SPECIAL CHARGES
   1. All charges and obligations for obtaining permits and inspections for fire suppression work shall be the responsibility of this Contractor, including items provided by the Owner such as described in Article 1.2.
   2. This Contractor shall apply for any utility service charge, installation or meter and gauge charge required and shall be responsible for the respective costs. Upon completion of the particular section of work the Contractor shall furnish the Owner with proof of acceptance from the proper local or state department having jurisdiction.

C. LICENSES
   1. All licenses required in connection with this work shall be secured and maintained by this Contractor with the proper local or state authority having jurisdiction

D. GUARANTEES
   1. This Contractor shall assume responsibility for any defects which may develop in any part of the systems caused by faulty workmanship, material or equipment, and agrees to replace any such faulty workmanship, material or equipment during a period of one year from date of final acceptance of the work without cost to Owner. Acceptance of the plant shall not waive this guarantee.
   2. This Contractor shall guarantee that there will be a complete, uniform and noiseless circulation of the fire extinguishing medium through the entire system of piping and equipment.

1.4 PRIOR APPROVAL

A. In any case where a specific trade name of equipment or material is mentioned and is followed by the term "or approved equal," it is to be understood as meaning to indicate the type and grade of equipment or material required and is not intended in any way to bar the use of alternate equipment or material of approved quality.

B. However, approval of any material or equipment other than that specified shall be obtained in writing from the Owners representative; otherwise the contractor shall furnish the material or equipment specified by name; similar approval is required for equipment to be furnished by subcontractors.

C. The Owners representative reserves the right to require the removal of any material or equipment which does not have his written approval and which does not comply with the Specifications, no matter at which state of installation such material or equipment is discovered.

D. Proposals must be based on the materials and equipment specifically mentioned in the Specifications or Addenda. Requests for substitutions shall be submitted to the Engineer within the time limits as specified in the General Conditions. Approval of such substitutions shall be made only by the issue of an Addendum sent to all bidding Contractors prior to the time bids are received. Requests for substitutions after this time will not be considered. The burden of proof rests with the proposer.

1.5 SCHEDULE OF EQUIPMENT & SUB-CONTRACTOR LIST

A. The Low Bidder shall submit a complete list of material and equipment proposed to be used to the Architect/Engineer within 5 working days after opening of Bids and before awarding of a Contract. Contractor shall include name of manufacturer, catalog or model numbers, ratings, descriptive information, etc., required to evaluate proposed substitution.

B. Submittal of alternate material by this Contractor shall be construed as meaning that he certifies that the proposed substituted item will fit the space provided, have capacity equal to or greater than that specified and shall be similar in construction, weight and finish.

C. Final approval of equipment and materials shall be based on manufacturer's shop drawings.

1.6 SHOP DRAWINGS

A. This Contractor shall be responsible for checking and submitting/uploading shop drawings and other pertinent information to submittal exchange for the Owner’s representative for approval. If approved, submittal is uploaded to Procore and stamped "Reviewed" or Reviewed with Comments". The drawings will remain on Procore for contractor reference. If notations and marks indicate that revised information is required before shop fabrications (or other work represented) can proceed, revised or corrected information shall be uploaded to submittal exchange for review.

B. Drawings shall be submitted/uploaded with such promptness as to cause no delay in contractor's work or work of other Contractors. Architect/Engineer will review shop drawings with reasonable promptness.

C. Drawings submitted/uploaded to Architect/Engineer shall be marked with the name of the project and bear the stamp of approval of Contractor as evidence that drawings have been checked, including all field dimensions by Contractor. Any drawings submitted without this stamp of approval will not be considered and will be returned to Contractor for resubmission.

D. Shop drawings for each of the following items which apply to this project shall be submitted to the Engineer:
   1. Spectrum Engineers

1.7 COST BREAKDOWN

A. At the time of submitting the schedule of equipment, the Contractor shall also submit a breakdown of construction costs, either on AIA form G702A or in a manner compatible with proposed pay requests. All items shall be broken down with respect to materials and labor.

1.8 EQUIPMENT DATA

A. Just prior to the issuing of a substantial completion certificate, this Contractor shall furnish the Owner complete catalog data, manufacturer's literature, and detailed manuals covering the operation and maintenance of all equipment specified under this section in 2 copies of hard bound booklet material. The literature shall be given to the Owner's operator with explanation at

the time of Owner's instruction. The literature shall be transferred with a submittal letter that shall be signed by the Owner's representative in receipt of instruction and information. All printed and written material shall be submitted to Engineer for approval and return before instruction. Failure to submit the equipment data will postpone the substantial completion status of the project and therefore, the payment associated with it.

1.9 INSTRUCTION TO OWNER

A. The Contractor shall also supervise the initial operation of all equipment and instruct the operator selected by the Owner in such operation as required to acquaint him thoroughly with the best practice. Instructions shall be in accordance with the system shown on plans and as specified. Lifetime shall inform the subcontractor 48 hours prior to when instructions are to be given and shall get signed Certificate indicating what items were instructed and names of people instructed and have it signed by each person instructed.

1.10 LUBRICATION

A. At the time of installation, and before any equipment is operated for either temporary conditions or performance tests, the Contractor shall properly lubricate all items as necessary according to the manufacturer's recommendations. Where special greases or oils are required, the contractor shall furnish to the Owner, at the time of Owner’s instruction, a one year's supply of such special lubricants.

1.11 SITE CONSIDERATIONS

A. SITE EXAMINATION

1. The Subcontractors shall visit the building site and become familiar with all the existing conditions before submitting bid. Failure to visit site will in no way relieve the successful bidder from necessity of furnishing any material or performing any work that may be required to complete the work in accordance with the drawings and specifications without additional cost to Owner.

1.12 AS-BUILT DRAWINGS

A. This Contractor shall maintain at the job site a set of drawings to be used specifically for recording changes from the contract documents. The information on outside underground work and utilities shall be dimensioned from easily recognizable reference points indicating both horizontal and vertical distances.

B. At the completion of the project digital copies of these drawings shall be submitted to the Engineer for processing.

1.13 TRADE CONSIDERATIONS

A. CORRELATION OF WORK AND LOCATION OF EQUIPMENT

1. Each Contractor shall give careful consideration to the work of all other trades and all subsidiary contractors and organize the work so that it will not interfere with work of

other trades. Consult the plumbing, sprinkling, heating, ventilating and electrical drawings and specifications for correlating information and the architectural and structural drawings for details, dimensions, foundations, structural elements, pits, etc. The Contractor shall verify all dimensions and conditions, and shall coordinate installation of equipment before fabricating ductwork, piping, etc.

2. The fire suppression piping shall be installed substantially as shown on the drawings. The exact position and required offsets of each and every pipe cannot be given by scaling the drawings but shall in every case be placed so as to avoid interference with other work. It is the Contractors responsibility to field measure piping prior to fabrication to avoid conflict with structure, ceiling heights and other trades. Should it be necessary to make changes in the location of piping and ductwork for its proper installation and operation, or to avoid conflict with other trades, it shall be done by this Contractor without extra charge to the contract.
3. Piping in finished rooms shall be concealed in partitions, furred spaces or suspended ceilings. In unfinished rooms, piping shall be arranged to provide for a maximum of head room.
4. It is intended that all apparatus be located symmetrical with Architectural elements and shall be installed at the height and locations as shown on the Architectural drawings wherever possible.

1.14 BASIC MATERIALS & METHODS

A. QUALITY

1. All materials and equipment shall be new and best quality, of the type best suited for the purpose intended, conform to the requirements of local and state codes governing the work involved, and be made by nationally recognized and substantially established manufacturers. The type and weight of material shall conform to the requirements of the latest standard specifications of the ASTM for that particular material.

B. FINISHES

1. All piping and equipment in finished areas shall be furnished and installed to present a neat and clean appearance. All surfaces except pipe that is to receive paint by General Contractor shall have a factory applied prime coat. All items that are to have finished paint by Fire Suppression Contractor shall have color selected by Architect/Engineer.

1.15 JOB SITE CONDITIONS

A. CONSTRUCTION CLEANING

1. All construction debris generated by the furnishing and installing of fire suppression equipment and systems shall be removed in a timely manner to prevent obstruction of other trades. Cartons, construction debris, piping, etc. shall be removed and the area brought to a "broom clean" finish.

B. CLEAN-UP

1. At the completion of the work, this Contractor shall remove all rubbish caused by his work from the premises and shall thoroughly clean all equipment and piping that was installed as part of this contract.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION 210100

SECTION 210500 - COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.1 SUMMARY

A. The Work of this Section includes:
   1. Sleeves without waterstop.
   2. Sleeves with waterstop.
   3. Sleeve-seal systems.
   4. Escutcheons.

1.2 ACTION SUBMITTALS

A. Product Data:

   1. For each type of product, excluding motors which are included in Part 1 of the fire-suppression equipment Sections.

      a. Include construction details, material descriptions, and dimensions of components.
      b. Include operating characteristics and furnished accessories.

B. Sustainable Design Submittals:

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.4 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

   1. Motor controllers.
   2. Torque, speed, and horsepower requirements of the load.
   3. Ratings and characteristics of supply circuit and required control sequence.
   4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 SLEEVES AND SLEEVE SEALS

A. Sleeves without Waterstop:

1. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron, with plain ends.
2. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, hot-dip galvanized, with plain ends.
3. Steel Sheet Sleeves: ASTM A653/A653M, 24 gauge minimum thickness; hot-dip galvanized, round tube closed with welded longitudinal joint.
4. PVC Pipe Sleeves: ASTM D1785, Schedule 40.
5. Molded-PVC Sleeves: With nailing flange.
6. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange.

B. Sleeves with Waterstop:
1. Description: Manufactured steel, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall.

C. Sleeve-Seal Systems:
1. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

a. Hydrostatic Seal: 20 psig minimum.
b. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size.
c. Pressure Plates: Carbon steel.
d. Connecting Bolts and Nuts: Carbon steel, with ASTM B633 coating of length required to secure pressure plates to sealing elements.

2.2 ESCUTCHEONS

A. Escutcheon Types:

1. One-Piece, Steel Type: With polished, chrome-plated finish and setscrew fastener.
2. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped steel with polished, chrome-plated finish and spring-clip fasteners.
3. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.
4. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed hinge; and spring-clip fasteners.

B. Floor Plates:

1. Split Floor Plates: Steel with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPE LOOPS AND SWING CONNECTIONS

A. Install pipe loops and offsets in accordance with NFPA 13 requirements for expansion and contraction compensation.

3.2 INSTALLATION OF SLEEVES, GENERAL

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 2-inch annular clear space between piping and concrete slabs and walls.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
2. Cut sleeves to length for mounting flush with both surfaces.

    a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.

3. Using grout or silicone sealant, seal space outside of sleeves in floors/slabs/walls without sleeve-seal system. Select to maintain fire-resistance of floor/slab/wall.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants that joint sealant manufacturer's literature indicates is appropriate for size, depth, and location of joint.

E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping."

3.3 INSTALLATION OF SLEEVES WITH WATERSTOP

A. Install sleeve with waterstop as new walls and slabs are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange centered across width centered in concrete slab or wall.

C. Secure nailing flanges to wooden concrete forms.

D. Using grout or silicone sealant, seal space around outside of sleeves.

3.4 INSTALLATION OF SLEEVE-SEAL SYSTEMS

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building, and passing through exterior walls.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.5 INSTALLATION OF ESCUTCHEONS

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

3.6 FIELD QUALITY CONTROL

A. Sleeves and Sleeve Seals:

1. Perform the following tests and inspections:

a. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.
b. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.

2. Prepare test and inspection reports.

B. Escutcheons:

1. Using new materials, replace broken and damaged escutcheons and floor plates.

3.7 SLEEVES APPLICATION

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above and below Grade:

a. Sleeves with waterstops.

1) Select sleeve size to allow for 2-inch annular clear space between piping and sleeve for installing sleeve-seal system.

2. Concrete Slabs-on-Grade:

a. Sleeves with waterstops.

1) Select sleeve size to allow for 2-inch annular clear space between piping and sleeve for installing sleeve-seal system.

3. Concrete Slabs above Grade:

a. Sleeves with waterstops.

4. Interior Walls and Partitions:

a. Sleeves without waterstops.

3.8 ESCUTCHEONS APPLICATION

A. Escutcheons for New Piping:

1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
2. Chrome-Plated Piping: One piece, steel or split plate steel with polished, chrome-plated finish.
3. Insulated Piping:

a. One piece, steel with polished, chrome-plated finish.

4. Bare Piping at Wall and Floor Penetrations in Finished Spaces:

a. One piece, steel with polished, chrome-plated finish.

5. Bare Piping at Ceiling Penetrations in Finished Spaces:

a. One piece, steel with polished, chrome-plated finish.

6. Bare Piping in Unfinished Service Spaces:

a. One piece, steel with polished, chrome-plated finish.

7. Bare Piping in Equipment Rooms:

a. One piece, steel with polished, chrome-plated finish.

B. Install floor plates for piping penetrations of equipment room floors.

C. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. New Piping and Relocated Existing Piping: One piece, floor plate.

END OF SECTION 210500

SECTION 210529 - HANGERS AND SUPPORTS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe hangers and supports for fire-suppression piping - metal.
2. Pipe hangers for fire-suppression piping - metal, trapeze type.
3. Fastener systems.
4. Equipment supports.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment" for vibration isolation devices and seismic restraints.

1.2 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers.
2. Equipment supports.

C. Delegated Design Submittals: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of trapeze hangers.
2. Include design calculations for designing trapeze hangers.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.4 QUALITY ASSURANCE

A. Structural-Steel Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.

B. Pipe Welding Qualifications: Qualify procedures and operators in accordance with 2021 ASME Boiler and Pressure Vessel Code, Section IX.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design trapeze pipe hangers and equipment supports.

B. Structural Performance: Hangers and supports for fire-suppression piping and equipment are to withstand the effects of gravity loads and stresses within limits and under conditions indicated in accordance with ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

C. NFPA Compliance: Comply with NFPA 13.

D. UL Compliance: Comply with UL 203.

2.2 PIPE HANGERS AND SUPPORTS FOR FIRE-SUPPRESSION PIPING - METAL

A. Pipe Hangers and Supports for Fire-Suppression Piping - Carbon Steel:
1. Description: Factory-fabricated components, NFPA approved, UL listed, or FM Global approved for fire-suppression piping support.
2. Galvanized Metallic Coatings: Pregalvanized or hot-dip galvanized.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

2.3 PIPE HANGERS FOR FIRE-SUPPRESSION PIPING - METAL, TRAPEZE TYPE

A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly, made from structural-carbon-steel shapes, with NFPA-approved, UL-listed, or FM Global-approved carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.4 FASTENER SYSTEMS

A. Fastener System - NFPA/UL/FM Powder-Actuated Fasteners: NFPA-approved, UL-listed, or FM Global-approved threaded-steel stud, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Fastener System - NFPA/UL/FM Mechanical-Expansion Anchors: NFPA-approved, UL-listed, or FM Global-approved, insert-wedge-type anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
   1. Indoor Applications: Zinc coated or Stainless.
   2. Outdoor Applications: Stainless steel.

2.5 EQUIPMENT SUPPORTS

A. Description: NFPA-approved, UL-listed, or FM Global-approved, welded, shop- or field-fabricated equipment support, made from structural-carbon-steel shapes.

2.6 MATERIALS

A. Aluminum: ASTM B221 (ASTM B221M).

B. Carbon Steel: ASTM A1011/A1011M.

C. Structural Steel: ASTM A36/A36M, carbon-steel plates, shapes, and bars; black and galvanized.

D. Stainless Steel: ASTM A240/A240M.

E. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout, suitable for interior and exterior applications.

   1. Properties: Nonstaining, noncorrosive, and nongaseous.
   2. Design Mix: 5000 psi (34.5 MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.

B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry static loads within specified loading limits. Minimum static design load used for strength determination is to comply with NFPA 13 requirements, minimum 5 times the water-filled weight of piping and supported components plus 250 lb (114 kg).

3.2 INSTALLATION OF HANGERS AND SUPPORTS

A. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, permit freedom of movement between pipe anchors, and facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

B. Install lateral bracing with pipe hangers and supports to prevent swaying.

C. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 (DN 65) and larger and at changes in direction of piping. Coordinate location of concrete inserts before concrete is placed.

D. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

E. Pipe Slopes: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

F. Metal Pipe-Hanger Installation: Comply with installation requirements of approvals and listings. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

G. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size, or install intermediate supports for smaller-diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A36/A36M carbon-steel shapes selected for loads being supported. Weld steel in accordance with AWS D1.1/D1.1M.

H. Thermal Hanger-Shield Installation: Install in pipe hanger or shield for insulated piping.

I. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick in concrete, after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners in accordance with powder-actuated tool manufacturer's operating manual. Install in accordance with approvals and listings.
2. Install mechanical-expansion anchors in concrete, after concrete is placed and completely cured. Install fasteners in accordance with manufacturer's written instructions. Install in accordance with approvals and listings.

J. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

K. Equipment Support Installation:

1. Fabricate from welded-structural-steel shapes.

2. Grouting: Place grout under supports for floor-mounted equipment and make bearing surface smooth.
3. Provide lateral bracing, to prevent swaying.

3.3 INSTALLATION OF EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment, and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections, so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches (40 mm).

3.6 PAINTING

A. Touchup:

1. Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

a. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils (0.05 mm).

2. Cleaning and touchup painting of field welds, bolted connections, and abraded, shop-painted areas on miscellaneous metal are specified in Section 099123 "Interior Painting."

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A780/A780M.

3.7 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with NFPA requirements for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.

F. Use stainless steel pipe hangers and stainless steel or corrosion-resistant attachments for hostile environment applications.

G. Use thermal hanger-shield inserts for insulated piping and tubing.

H. Horizontal-Piping Hangers and Supports: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
2. Steel Pipe Clamps (MSS Type 4): For suspension of NPS 1/2 to NPS 24 (DN 15 to DN 600) if little or no insulation is required.
3. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
4. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8 (DN 10 to DN 200).
5. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3 (DN 10 to DN 80).
6. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
7. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.

8. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
9. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 (DN 65 to DN 900) if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.

I. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24 (DN 24 to DN 600).
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 (DN 20 to DN 600) if longer ends are required for riser clamps.

J. Hanger-Rod Attachments: Comply with NFPA requirements.

K. Building Attachments: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable-Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. C-Clamps (MSS Type 23): For structural shapes.
3. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.

L. Saddles and Shields: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal Hanger-Shield Inserts: For supporting insulated pipe.

M. Comply with NFPA requirements for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

N. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 210529

SECTION 210548 - VIBRATION AND SEISMIC CONTROLS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Restraints - rigid type.
   2. Restraints - cable type.
   3. Restraint accessories.
   4. Post-installed concrete anchors.
   5. Concrete inserts.

1.2 DEFINITIONS

A. Designated Seismic System: An architectural, mechanical, electrical, plumbing, or fire-protection system and its components for which the component importance factor is greater than 1.0 when determined in accordance with Section 018123 "Facility Seismic and Wind Criteria."

B. IBC: International Building Code.

C. OSHPD: Office of Statewide Health Planning and Development (for the State of California owned and regulated medical facilities).

1.3 DELEGATED DESIGN SERVICES

A. Delegated Design Professional: Engage qualified professional structural engineer to design seismic and wind restraints.

1.4 ACTION SUBMITTALS

A. Product Data:

   1. For each type of product.

      a. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
      b. Include load rating for each seismic-restraint device.
      c. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device and seismic-restraint component.
      d. Annotate types and sizes of seismic restraints and accessories, complete with listing markings or report numbers and load rating in tension and compression as evaluated by UL product listing FM Approvals an agency acceptable to authorities having jurisdiction.

e. Annotate to indicate application of each product submitted and compliance with requirements.
f. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Shop Drawings:

1. Detail fabrication and assembly of equipment bases.
2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
3. Show coordination of seismic restraints for components with other systems and equipment in the vicinity, including other supports and other seismic restraints.

C. Delegated Design Submittal:

1. All delegated design and submittals for seismic restraints must be signed and sealed by a qualified professional structural engineer responsible for their preparation. Structural engineer is to possess qualifications specified in Section 014000 "Quality Requirements," with expertise in structural engineering, including design of seismic and wind restraints, equipment hangers and supports, and concrete attachments.
2. For each seismic-restraint device, including seismic-restrained mounting, pipe-riser resilient support, seismic restraint, seismic-restraint accessory, and concrete anchor and insert that is required by this Section or is indicated on Drawings, submit the following:

a. Seismic Restraint, and Vibration Isolator Selection: Select and submit seismic restraints complying with performance requirements, design criteria, and analysis data.
b. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, and seismic loads. Include certification by professional engineer that riser system was examined for excessive stress and that none exists.
c. Post-Installed Concrete Anchors and Concrete Inserts: Include calculations showing anticipated seismic loads. Include certification that device is approved by an NRTL for reinforcement use.
d. Seismic Design Calculations: Submit all input data and loading calculations.

3. Seismic- and Wind-Restraint Detail Drawing:

a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.

4. Product Listing, Preapproval, and Evaluation Documentation: By UL FM Approvals an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

5. Riser Supports: Include riser diagrams and calculations showing initial and final loads on building structure, and seismic loads. Include certification that riser system was examined for excessive stress and that none exists.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of vibration isolation and seismic-restraint devices for fire-suppression piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.

B. Qualification Data: For professional engineer and testing agency.

C. Welding certificates.

D. Field quality-control reports.

1.6 REGULATORY AGENCY APPROVALS

A. Delegated design submittals and Shop Drawings requiring approval by authorities having jurisdiction must be signed by qualified structural professional engineer responsible for their preparation. Obtain approval by authorities having jurisdiction prior to submitting for action by Architect.

1.7 QUALIFICATIONS

A. Professional Structural Engineer: Professional engineer possessing active qualifications specified in Section 014000 "Quality Requirements," with expertise in structural engineering, including design of seismic and wind restraints, equipment hangers and supports, and concrete foundations.

1.8 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional structural engineer to prepare seismic- and wind-restraint calculations in accordance with criteria specified in Section 018123 "Facility Seismic and Wind Criteria."

B. Seismic- and Wind-Restraint-Device Ratings: Devices are to be tested and rated in accordance with applicable code requirements and authorities having jurisdiction. Devices are to be listed by a nationally recognized third party that requires periodic follow-up inspections and has a

listing directory available to the public. Provide third-party listing by one or more of the following: UL product listing FM Approvals an agency acceptable to the authorities having jurisdiction.

C. Consequential Damage: Provide additional seismic restraints for suspended components or anchorage of floor-, roof-, or wall-mounted components so that failure of a nonessential or essential component will not cause failure of any other essential building component.

D. Fire/Smoke Resistance: Seismic- and wind-restraint devices that are not constructed of ferrous metals are to have a maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested by qualified testing laboratory in accordance with ASTM E84 or UL 723 and be labeled as such.

E. Component Supports:

1. Load ratings, features, and applications of reinforcement components are to be based on testing standards of qualified testing laboratory.

2.2 RESTRAINTS - RIGID TYPE

A. Source Limitations: Obtain rigid-type restraints from single manufacturer.

B. Description: Shop- or field-fabricated bracing assembly made of AISI S110-07-S1 slotted steel channels, ANSI/ASTM A53/A53M steel pipe as per NFPA 13, or other rigid steel brace member. Includes accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.3 RESTRAINTS - CABLE TYPE

A. Source Limitations Obtain cable-type restraints from single manufacturer.

B. Seismic- and Wind-Restraint Cables: ASTM A1023/A12023M galvanized or ASTM A603 galvanized-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for seismic restraining cable service; with fittings attached by means of poured socket, swaged socket or mechanical (Flemish eye) loop.

C. Restraint cable assembly with cable fittings must comply with ASCE/SEI 19. All cable fittings and complete cable assembly must maintain the minimum cable breaking force. U-shaped cable clips and wedge-type end fittings do not comply and are unacceptable.

2.4 RESTRAINT ACCESSORIES

A. Source Limitations: Obtain restraint accessories from single manufacturer.

B. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod. Non-metallic stiffeners are unacceptable.

C. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid restraints and restraint cables.

D. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

E. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.

F. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.5 POST-INSTALLED CONCRETE ANCHORS

A. Mechanical Anchor Bolts:
1. Source Limitations: Obtain mechanical anchor bolts from single manufacturer.
2. Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength for anchor and as tested according to ASTM E488/E488M.

B. Adhesive Anchor Bolts:
1. Source Limitations: Obtain adhesive anchor bolts from single manufacturer.
2. Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488/E488M.

C. Provide post-installed concrete anchors that have been prequalified for use in seismic applications. Post-installed concrete anchors must comply with all requirements of ASCE/SEI 7-05, Ch. 13.

1. Prequalify post-installed anchors in concrete in accordance with ACI 355.2 or other approved qualification testing procedures.
2. Prequalify post-installed anchors in masonry in accordance with approved qualification procedures.

D. Expansion-type anchor bolts are not permitted for equipment in excess of 10 hp (7.46 kW) that is not vibration isolated.

1. Undercut expansion anchors are permitted.

2.6 CONCRETE INSERTS

A. Source Limitations: Obtain concrete inserts from single manufacturer.

B. Provide preset concrete inserts that are seismically prequalified in accordance with ICC-ES AC466 testing.

C. Comply with ANSI/MSS SP-58.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-restraint devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

B. Hanger-Rod Stiffeners: Install where where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Assemblies: Where not specifically indicated otherwise, select sizes of components so strength is adequate to carry static and seismic loads within specified loading limits.

3.3 INSTALLATION OF VIBRATION CONTROLS AND SEISMIC RESTRAINTS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

A. Provide vibration-control devices for systems and equipment where indicated in Equipment Schedules or Fire-Suppression Vibration Isolation, Seismic-Restraint, and Wind-Restraint Schedules, where indicated on Drawings, or where the Specifications indicate they are to be installed on specific equipment and systems.

B. Provide seismic-restraintdevices for systems and equipment where indicated in Equipment Schedules or Vibration Isolation, Seismic-Restraint, and Wind-Restraint Schedules, where indicated on Drawings, where the Specifications indicate they are to be installed on specific equipment and systems, and where required by applicable codes.

C. Coordinate location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."

D. Installation of vibration isolators and seismic restraints must not cause any stresses, misalignment, or change of position of equipment or piping.

E. Comply with installation requirements of NFPA 13 for installation of all seismic-restraint devices.

F. Comply with requirements in Section 077200 "Roof Accessories" for installation of equipment supports and roof penetrations.

G. Equipment Restraints:

1. Install snubbers on fire-suppression equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).
3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.

H. Piping Restraints:

1. Comply with all requirements in NFPA 13.
2. Design piping sway bracing in accordance with NFPA 13.

    a. Maximum spacing of all sway bracing to be no greater than indicated in NFPA 13.
    b. Design loading of all sway bracing not to exceed values indicated in NFPA 13.

I. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.

J. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

K. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

L. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

M. Post-Installed Concrete Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Mechanical Anchor Bolts: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors to be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchor Bolts: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole

and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross structural seismic joints and other points where differential movement may occur, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Section 211000 "Water-Based Fire-Suppression Systems" for piping flexible connections.

3.5 ADJUSTING

A. Adjust isolators after system is at operating weight.

B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test at no fewer than four of each type and size of installed anchors and fasteners selected by Architect.
5. Test to 90 percent of rated proof load of device.
6. Measure isolator restraint clearance.
7. Measure isolator deflection.
8. Verify snubber minimum clearances.

D. Remove and replace malfunctioning units and retest as specified above.

E. Units will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

END OF SECTION 210548

SECTION 210553 - IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Warning tape
4. Pipe labels.
5. Stencils.
6. Valve tags.
7. Warning tags.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment-Label Schedule: Include a listing of all equipment to be labeled and the proposed content for each label.

D. Valve-numbering scheme.

E. Valve Schedules: Provide for fire-suppression piping system. Include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:
1. Material and Thickness: Brass, 0.032 inch anodized aluminum, 0.032 inch thick, with predrilled or stamped holes for attachment hardware.
2. Letter and Background Color: As indicated for specific application under Part 3.
3. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
4. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
5. Fasteners: Stainless steel rivets or self-tapping screws.

6. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:
1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, with predrilled holes for attachment hardware.
2. Letter and Background Color: As indicated for specific application under Part 3.
3. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.
4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
6. Fasteners: Stainless steel rivets or self-tapping screws.
7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, with predrilled holes for attachment hardware.

B. Letter and Background Color: As indicated for specific application under Part 3.

C. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.

D. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

E. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

F. Fasteners: Stainless steel rivets or self-tapping screws.

G. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

H. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 WARNING TAPE

A. Material: Vinyl.

B. Minimum Thickness: 0.005 inch.

C. Letter, Pattern, and Background Color: As indicated for specific application under Part 3.

D. Waterproof Adhesive Backing: Suitable for indoor or outdoor use.

E. Maximum Temperature: 160 deg F.

F. Minimum Width: 2 inches.

2.4 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color coded, with lettering indicating service and showing flow direction in accordance with ASME A13.1.

B. Letter and Background Color: As indicated for specific application under Part 3.

C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.

D. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

E. Pipe-Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings. Also include the following:
   1. Flow-Direction Arrows: Include flow-direction arrows on main distribution piping. Arrows may be either integral with label or applied separately.
   2. Lettering Size: Size letters in accordance with ASME A13.1 for piping.

2.5 STENCILS

A. Stencils for Piping:
   1. Lettering Size: Size letters in accordance with ASME A13.1 for piping.
   2. Stencil Material: Aluminum, brass, or fiberboard.
   3. Letter and Background Color: As indicated for specific application under Part 3.

2.6 VALVE TAGS

A. Description: Stamped or engraved with 1/4-inch letters for piping-system abbreviation and 1/2-inch numbers.

   1. Tag Material: Brass, 0.04 inch aluminum, 0.031 inch oranodized aluminum, 0.031 inch thick, with predrilled or stamped holes for attachment hardware.
   2. Fasteners: Brass link chain.

B. Letter and Background Color: As indicated for specific application under Part 3.

C. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Include valve-tag schedule in operation and maintenance data.

2.7 WARNING TAGS

A. Description: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches minimum.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption, such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Letter and Background Color: As indicated for specific application under Part 3.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

3.2 INSTALLATION GENERAL REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be installed.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

D. Locate identifying devices so that they are readily visible from the point of normal approach.

3.3 INSTALLATION OF EQUIPMENT LABELS, WARNING SIGNS, AND LABELS

A. Permanently fasten labels on each item of fire-suppression equipment.

B. Sign and Label Colors:

1. White letters on an ANSI Z535.1 safety-red background.

C. Locate equipment labels where accessible and visible.

3.4 INSTALLATION OF WARNING TAPE

A. Warning Tape Color and Pattern: Yellow background with black diagonal stripes.

B. Install warning tape on pipes and ducts, with cross-designated walkways providing less than 6 ft. of clearance.

C. Locate tape so as to be readily visible from the point of normal approach.

3.5 INSTALLATION OF PIPE LABELS

A. Piping Color Coding: Painting of piping is specified in Section 099123 "Interior Painting."

B. Install pipe labels showing service and flow direction with permanent adhesive on pipes.

C. Stenciled Pipe-Label Option: Stenciled labels showing service and flow direction may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, with painted, color-coded bands or rectangles on each piping system.

1. Identification Paint: Use for contrasting background.
2. Stencil Paint: Use for pipe marking.

D. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Within 3 ft. of each valve and control device.
2. At access doors, manholes, and similar access points that permit a view of concealed piping.
3. Within 3 ft. of equipment items and other points of origination and termination.
4. Spaced at maximum intervals of 25 ft. along each run. Reduce intervals to 10 ft. in areas of congested piping and equipment.

E. Flow- Direction Arrows: Provide arrows to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

F. Fire-Suppression Pipe Label Color Schedule:

1. Fire-Suppression Pipe Labels: White letters on an ANSI Z535.1 safety-red background.

3.6 INSTALLATION OF VALVE TAGS

A. Valve-Tag Application Schedule: Tag valves according to size, shape, and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below.

1. Valve-Tag Size and Shape:

a. Fire-Suppression Standpipe: 1-1/2 inches, round.
b. Wet-Pipe Sprinkler System: 1-1/2 inches, round.

2. Valve-Tag Color: White letters on an ANSI Z535.1 safety-red background.

3.7 INSTALLATION OF WARNING TAGS

A. Warning Tag Color: Black letters on an ANSI Z535.1 safety-yellow background.

B. Attach warning tags, with proper message, to equipment and other items where scheduled.

END OF SECTION 210553

SECTION 21 08 00
COMMISSIONING OF FIRE SUPPRESSION SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. This section includes specific requirements that apply to the implementation of the Commissioning Process and this Division Contractors' participation in this process. This section details the project specific equipment and systems that are included in the Commissioning Process. For general descriptions and responsibilities, refer to SECTION 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

1.02 RELATED DOCUMENTS

A. The Owner's Project Requirements (OPR) document.

B. The Basis of Design (BoD) document.

C. The Project Commissioning Plan (CxP) document.

D. ASHRAE Standard 202-2013 - Commissioning Process for Buildings and Systems.

E. NFPA 3 – Standard for Commissioning Fire Protection and Life Safety Systems.

F. NFPA 4 – Standard for Integrated Fire Protection and Life Safety System Testing.

1.03 RELATED SECTIONS

A. SECTION 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS

B. SECTION 07 08 00 - COMMISSIONING OF THERMAL AND MOISTURE PROTECTION

C. SECTION 08 08 00 - COMMISSIONING OF OPENINGS

D. SECTION 11 08 00 - COMMISSIONING OF EQUIPMENT

E. SECTION 13 08 00 - COMMISSIONING OF SPECIAL CONSTRUCTION

F. SECTION 14 08 00 - COMMISSIONING OF CONVEYING SYSTEMS

G. SECTION 22 08 00 - COMMISSIONING OF PLUMBING SYSTEMS

H. SECTION 23 08 00 - COMMISSIONING OF MECHANICAL SYSTEMS

I. SECTION 25 08 00 - COMMISSIONING OF INTEGRATED AUTOMATION SYSTEMS

J. SECTION 26 08 00 - COMMISSIONING OF ELECTRICAL SYSTEMS

K. SECTION 27 08 00 - COMMISSIONING OF COMMUNICATIONS SYSTEMS

L. SECTION 28 08 00 - COMMISSIONING OF SAFETY AND SECURITY SYSTEMS

M. SECTION 33 08 00 - COMMISSIONING OF UTILITIES

1.04 DEFINITIONS

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

1.05 RESPONSIBILITIES

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

PART 2 PRODUCTS

2.01 NO PRODUCTS SUPPLIED

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

B. Contractors and/or Vendors shall provide the specialty testing equipment necessary to fulfill the functional testing requirements, for the duration of the testing period.

PART 3 EXECUTION

3.01 GENERAL

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.02 MEETINGS

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.03 SYSTEM START-UP

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.04 PRE-FUNCTIONAL CHECKLISTS

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.05 FUNCTIONAL PERFORMANCE TESTING

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.06 TRAINING

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.07 SYSTEMS TO BE COMMISSIONED

A. GENERAL
   1. Commissioning specifications supplement the requirements of individual specifications sections but shall not be interpreted to replace or diminish the specified scope of any individual section.
   2. For all systems listed below, Division Contractor shall comply with all commissioning requirements specified.

B. APPLICABLE SYSTEMS
   1. Identification for Fire Suppression
   2. Hangers and Supports for Fire-Suppression
   3. Wet-Pipe Sprinkler Systems

END OF SECTION

SECTION 21 08 00
COMMISSIONING OF FIRE SUPPRESSION SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. This section includes specific requirements that apply to the implementation of the Commissioning Process and this Division Contractors' participation in this process. This section details the project specific equipment and systems that are included in the Commissioning Process. For general descriptions and responsibilities, refer to SECTION 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

1.02 RELATED DOCUMENTS

A. The Owner's Project Requirements (OPR) document.

B. The Basis of Design (BoD) document.

C. The Project Commissioning Plan (CxP) document.

D. ASHRAE Standard 202-2013 - Commissioning Process for Buildings and Systems.

E. LEED v4 for Building Design and Construction.

1.03 RELATED SECTIONS

A. SECTION 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS

B. SECTION 07 08 00 - COMMISSIONING OF THERMAL AND MOISTURE PROTECTION

C. SECTION 08 08 00 - COMMISSIONING OF OPENINGS

D. SECTION 11 08 00 - COMMISSIONING OF EQUIPMENT

E. SECTION 13 08 00 - COMMISSIONING OF SPECIAL CONSTRUCTION

F. SECTION 14 08 00 - COMMISSIONING OF CONVEYING SYSTEMS

G. SECTION 22 08 00 - COMMISSIONING OF PLUMBING SYSTEMS

H. SECTION 23 08 00 - COMMISSIONING OF MECHANICAL SYSTEMS

I. SECTION 25 08 00 - COMMISSIONING OF INTEGRATED AUTOMATION SYSTEMS

J. SECTION 26 08 00 - COMMISSIONING OF ELECTRICAL SYSTEMS

K. SECTION 27 08 00 - COMMISSIONING OF COMMUNICATIONS SYSTEMS

L. SECTION 28 08 00 - COMMISSIONING OF SAFETY AND SECURITY SYSTEMS

M. SECTION 33 08 00 - COMMISSIONING OF UTILITIES

1.04 DEFINITIONS

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

1.05 RESPONSIBILITIES

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

PART 2 PRODUCTS

2.01 NO PRODUCTS SUPPLIED

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

B. Contractors and/or Vendors shall provide the specialty testing equipment necessary to fulfill the functional testing requirements, for the duration of the testing period.

PART 3 EXECUTION

3.01 GENERAL

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.02 MEETINGS

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.03 SYSTEM START-UP

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.04 PRE-FUNCTIONAL CHECKLISTS

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.05 FUNCTIONAL PERFORMANCE TESTING

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.06 TRAINING

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.07 SYSTEMS TO BE COMMISSIONED

A. GENERAL
   1. Commissioning specifications supplement the requirements of individual specifications sections but shall not be interpreted to replace or diminish the specified scope of any individual section.
   2. For all systems listed below, Division Contractor shall comply with all commissioning requirements specified.

B. APPLICABLE SYSTEMS
   1. Identification for Fire Suppression
   2. Hangers and Supports for Fire-Suppression
   3. Wet-Pipe Sprinkler Systems

END OF SECTION

SECTION 211313 – WATER BASED FIRE-SUPPRESSION SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pipes, fittings, and specialties.
2. Sprinklers.

1.3 DEFINITIONS

A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175-psig maximum.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For wet-pipe sprinkler systems.

1. Include plans, elevations, sections, and attachment details.
2. Include diagrams for power, signal, and control wiring.

C. Delegated-Design Submittal: For wet-pipe sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Domestic water piping.
2. HVAC ductwork.
3. Cable tray.

4. Items penetrating finished ceiling include the following:

    a. Lighting fixtures.
    b. Air outlets and inlets.

B. Qualification Data: For qualified Installer.

C. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

D. Welding certificates.

E. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."

F. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wet-pipe sprinkler systems and specialties to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

1.8 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

    a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

B. Welding Qualifications: Qualify procedures and operators according to 2010 ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:

NFPA 13, 2019 Edition.

B. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

C. Delegated Design: Engage a qualified professional engineer or NICET Level III technician to design wet-pipe sprinkler systems.

1. Sprinkler system design shall be approved by authorities having jurisdiction.

a. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
b. Sprinkler Occupancy Hazard Classifications:

1) Automobile Parking Areas: Ordinary Hazard, Group 1.
2) Building Service Areas: Ordinary Hazard, Group 1.
3) Electrical Equipment Rooms: Ordinary Hazard, Group 1.
4) General Storage Areas: Ordinary Hazard, Group 1.
5) Machine Shops: Ordinary Hazard, Group 2.
6) Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
7) Office and Public Areas: Light Hazard.

2. Minimum Density for Automatic-Sprinkler Piping Design:
a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area.
d. Special Occupancy Hazard: As determined by authorities having jurisdiction.

D. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7.

2.2 STEEL PIPE AND FITTINGS

A. Standard-Weight, Black-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.

B. Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.

C. Steel Couplings: ASTM A 865/A 865M, threaded.

D. Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

E. Malleable- or Ductile-Iron Unions: UL 860.

F. Cast-Iron Flanges: ASME 16.1, Class 125.

G. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.

1. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick ASME B16.21, nonmetallic and asbestos free or EPDM rubber gasket.

a. Class 125 and Class 250, Cast-Iron, Flat-Face Flanges: Full-face gaskets.
b. Class 150 and Class 300, Ductile-Iron or -Steel, Raised-Face Flanges: Ring-type gaskets.

2. Metal, Pipe-Flange Bolts and Nuts: Carbon steel unless otherwise indicated.

H. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.

1. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

I. Grooved-Joint, Steel-Pipe Appurtenances:
1. Pressure Rating: 175-psig minimum.
2. Painted Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting, with dimensions matching steel pipe.
3. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213 rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.3 SPECIALTY VALVES

A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

B. Pressure Rating:

1. Standard-Pressure Piping Specialty Valves: 175-psig minimum.

C. Body Material: Cast or ductile iron.

D. Size: Same as connected piping.

E. End Connections: Flanged or grooved.

2.4 SPRINKLER PIPING SPECIALTIES

A. Branch Outlet Fittings:
1. Standard: UL 213.
2. Pressure Rating: 175-psig minimum.
3. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
4. Type: Mechanical-tee and -cross fittings.
5. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
6. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.

7. Branch Outlets: Grooved, plain-end pipe, or threaded.

B. Flexible Sprinkler Hose Fittings:
   1. Standard: UL 1474.
   2. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
   3. Pressure Rating: 175-psig minimum.
   4. Size: Same as connected piping, for sprinkler.

2.5 SPRINKLERS

A. Acceptable Manufacturers:
   1. Reliable.
   2. Tyco.
   3. Victualic.
   4. Viking.

B. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

C. Pressure Rating for Automatic Sprinklers: 175-psig minimum.

D. Automatic Sprinklers with Heat-Responsive Element:
   1. Nonresidential Applications: UL 199.
   2. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

E. Sprinkler Finishes: Match existing sprinklers in area.

F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

   1. Ceiling Mounting: Chrome-plated steel or factory painted to match ceiling, two piece, with 1-inch vertical adjustment.
   2. Sidewall Mounting: Chrome-plated steel or factory painted to match ceiling, two piece, flat.

G. Sprinkler Guards:
   1. Standard: UL 199.
   2. Type: Wire cage with fastening device for attaching to sprinkler.

PART 3 - EXECUTION

3.1 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.

B. Report test results promptly and in writing.

3.2 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

B. Piping Standard: Comply with NFPA 13 requirements for installation of sprinkler piping.

C. Install seismic restraints on piping. Comply with NFPA 13 requirements for seismic-restraint device materials and installation.

D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

E. Install unions adjacent to each valve in pipes NPS 2 and smaller.

F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

H. Install sprinkler piping with drains for complete system drainage.

I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

J. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.

K. Install alarm devices in piping systems.

L. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13. In seismic-rated areas, refer to Section 210548 "Seismic Controls for Fire-Suppression Piping and Equipment."

M. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft-metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they are not subject to freezing.

N. Fill sprinkler system piping with water.

O. Install sleeve seals for piping penetrations of concrete walls and slabs.

P. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 210518 "Escutcheons for Fire-Suppression Piping."

3.3 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

H. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.

1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

I. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

3.4 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

D. Specialty Valves:

1. Install valves in vertical position for proper direction of flow, in main supply to system.

3.5 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels.

B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.

C. Install sprinklers into flexible, sprinkler hose fittings, and install hose into bracket on ceiling grid.

3.6 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

B. Identify system components, wiring, cabling, and terminals.

3.7 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
4. Energize circuits to electrical equipment and devices.
5. Coordinate with fire-alarm tests. Operate as required.
6. Verify that equipment hose threads are same as local fire department equipment.

B. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.8 CLEANING

A. Clean dirt and debris from sprinklers.

B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

3.9 DEMONSTRATION

A. Train the Owner's maintenance personnel to adjust, operate, and maintain the system.

END OF SECTION 211313

SECTION 22 0500

COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Motors.
2. Packless expansion joints.
3. Grooved-joint expansion joints.
4. Alignment guides and anchors.
5. Sleeves without waterstop.
6. Sleeves with waterstop.
7. Stack-sleeve fittings.
8. Sleeve-seal systems.
9. Grout.
10. Silicone sealants.
11. Escutcheons.
12. Thermometers, liquid in glass.
13. Pressure gauges, dial type.
14. Gauge attachments.
15. Portable differential pressure meter.
16. Test plugs.
17. Test-plug kits.

B. Related Requirements:

1. Section 221119 "Domestic Water Piping Specialties" for water meters.
2. Section 221513 "General-Service Compressed-Air Piping" for compressed air gauges.
3. Section 331415 "Site Water Distribution Piping" for domestic water meters and combined domestic and fire-protection water-service meters outside the building.

1.2 DEFINITIONS

A. Existing Piping to Remain: Existing piping that is not to be removed and that is not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.3 ACTION SUBMITTALS

A. Product Data:

1. For each type of product, excluding motors which are included in Part 1 of the plumbing equipment Sections.

    a. Include construction details, material descriptions, and dimensions of individual components, and finishes.
    b. Include operating characteristics and furnished accessories.

B. Delegated Design Submittals: For each anchor and alignment guide, including analysis data, signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
3. Alignment Guide Details: Detail field assembly and attachment to building structure.
4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of expansion joint, and gauge to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.

B. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators in accordance with 2021 ASME Boiler and Pressure Vessel Code, Section IX.

1.7 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Domestic water expansion fittings and loops for plumbing piping intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act, with requirements of authorities having jurisdiction, and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

B. Compatibility: Provide products suitable for piping service fluids, materials, working pressures, and temperatures.

C. Capability: Provide products and installations to accommodate maximum axial movement as scheduled or indicated on Drawings.

2.2 MOTORS

A. Motor Requirements, General:

1. Content includes motors for use on alternating-current power systems of up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.
2. Comply with requirements in this Section except when stricter requirements are specified in equipment schedules or Sections.
3. Comply with NEMA MG 1 unless otherwise indicated.
4. Comply with IEEE 841 for severe-duty motors.

B. Motor Characteristics:

1. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 7000 ft. above sea level.
2. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

C. Polyphase Motors:

1. Description: NEMA MG 1, Design B, medium induction motor.
2. Efficiency: Premium Efficient, as defined in NEMA MG 1.
3. Service Factor: 1.15.
4. Multispeed Motors: Variable torque.

    a. For motors with 2:1 speed ratio, consequent pole, single winding.
    b. For motors with other than 2:1 speed ratio, separate winding for each speed.

5. Multispeed Motors, Two Winding: Separate winding for each speed.
6. Rotor: Random-wound, squirrel cage.
7. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
8. Temperature Rise: Match insulation rating.
9. Insulation: Class F.
10. Code Letter Designation:

    a. Motors 15 HP and Larger: NEMA starting Code F or Code G.
    b. Motors Smaller Than 15 HP: Manufacturer's standard starting characteristic.

11. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

D. Additional Requirements for Polyphase Motors:

1. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
2. Motors Used with Variable-Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

    a. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time-rise pulses produced by pulse-width-modulated inverters.
    b. Premium-Efficient Motors: Class B temperature rise; Class F insulation.
    c. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
    d. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

3. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

E. Single-Phase Motors:

1. Motors larger than 1/20 hp must be one of the following, to suit starting torque and requirements of specific motor application:

    a. Permanent-split capacitor.
    b. Split phase.
    c. Capacitor start, inductor run.
    d. Capacitor start, capacitor run.

2. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
3. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
4. Motors 1/20 HP and Smaller: Shaded-pole type.
5. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device will automatically reset when motor temperature returns to normal range.

2.3 EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

A. Performance Requirements:

1. Compatibility: Provide products suitable for piping service fluids, materials, working pressures, and temperatures.
2. Capability: Provide products and installations that will accommodate maximum axial movement as scheduled or indicated on Drawings.

B. Packless Expansion Joints:

1. Flexible-Hose Packless Expansion Joints, Lead Free: FHEJLF-01.
    a. Source Limitations: Obtain flexible-hose packless expansion joints from single manufacturer.
    b. Description: Manufactured assembly with inlet and outlet elbow fittings and two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose.
    c. Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.

d. Expansion Joints for Copper Tubing NPS 2 (DN 50) and Smaller: Copper-alloy fittings with solder-joint end connections.

1) Bronze hoses and single-braid bronze sheaths with 450 psig at 70 deg F and 340 psig at 450 deg F ratings.
2) Bronze hoses and double-braid bronze sheaths with 700 psig at 70 deg F and 500 psig at 450 deg F ratings.

e. Expansion Joints for Copper Tubing NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Copper-alloy fittings with threaded end connections.

1) Stainless steel hoses and single-braid, stainless steel sheaths with 300 psig at 70 deg F and 225 psig at 450 deg F ratings.
2) Stainless steel hoses and double-braid, stainless steel sheaths with 420 psig at 70 deg F and 315 psig at 450 deg F ratings.

2. Metal-Bellows Packless Expansion Joints, Lead Free: MBEJLF-01.
a. Source Limitations: Obtain metal-bellows packless expansion joints from single manufacturer.
b. Standards: ASTM F1120 and EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."
c. Type: Circular, corrugated bellows with external tie rods.
d. Minimum Pressure Rating: 175 psig unless otherwise indicated.
e. Configuration: double joint with base class(es) unless otherwise indicated.
f. Expansion Joints for Copper Tubing: Single- or multi-ply phosphor-bronze bellows, copper pipe ends, and brass shrouds.

1) End Connections for Copper Tubing NPS 2 (DN 50) and Smaller: Solder joint or threaded.
2) End Connections for Copper Tubing NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Solder joint or threaded.
3) End Connections for Copper Tubing NPS 5 (DN 125) and Larger: Flanged.

2.4 SLEEVES AND SLEEVE SEALS

A. Sleeves without Waterstop:

1. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron, with plain ends.
2. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, hot-dip galvanized, with plain ends.
3. Steel Sheet Sleeves: ASTM A653/A653M, 24 gauge minimum thickness; hot-dip galvanized, round tube closed with welded longitudinal joint.
4. PVC Pipe Sleeves: ASTM D1785, Schedule 40.
5. Molded-PVC Sleeves: With nailing flange.
6. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange.

B. Sleeves with Waterstop:
1. Description: Manufactured PVC/HDPE steel stainless steel galvanized-steel, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall.

C. Stack-Sleeve Fittings:

1. Description: Manufactured, Dura-coated or Duco-coated galvanized cast-iron sleeve with integral clamping flange for use in waterproof floors and roofs. Include clamping ring, bolts, and nuts for membrane flashing.

    a. Underdeck Clamp: Clamping ring with setscrews.

D. Sleeve-Seal Systems:
1. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

    a. Hydrostatic Seal: 20 psig minimum.
    b. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
    c. Pressure Plates: Carbon steel.
    d. Connecting Bolts and Nuts: Carbon steel, with zinc coating, ASTM B633 of length required to secure pressure plates to sealing elements.

E. Grout:

1. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.
2. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
3. Design Mix: 5000 psi, 28-day compressive strength.
4. Packaging: Premixed and factory packaged.

F. Silicone Sealants:

1. Silicone Sealant, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant.
    a. Standard: ASTM C920, Type S, Grade NS, Class 25, Use NT.

2. Silicone Sealant, S, P, T, NT: Single-component, 25, pourable, movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant.
    a. Standard: ASTM C920, Type S, Grade P, Class 25, Uses T and NT.

3. Silicone Foam Sealant: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

2.5 ESCUTCHEONS

A. Escutcheon Types:
1. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
2. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped steel with polished, chrome-plated finish and spring-clip fasteners.

B. Floor Plates:

1. Split Floor Plates: Cast brass with concealed hinge. Polished chrome-plated finish.

2.6 METERS AND GAUGES FOR PLUMBING PIPING

A. Thermometers, Liquid in Glass, Plastic Case, Industrial Style:

1. Source Limitations: Provide liquid-in-glass, lead-free, plastic-case, industrial-style thermometers from single manufacturer.
2. Manufacturers: Subject to compliance with requirements provide products by one of the following:
   a. Weiss Instruments, Inc.: Model 9VU35.
3. Standard: ASME B40.200.
4. Case: Plastic; 9-inch nominal size unless otherwise indicated.
5. Case Form: Adjustable angle unless otherwise indicated.
6. Tube: Glass with magnifying lens and blue or red organic liquid, mercury free.
7. Tube Background: Nonreflective aluminum with permanent scale markings graduated in deg F.
8. Window: Glass.
9. Stem: Aluminum and of length to suit installation.

   a. Design for Thermowell Installation: Bare stem.

10. Connector: 1-1/4 inches, with ASME B1.1 or ASME B1.20.1 screw threads to fit thermowell.
11. Accuracy: Plus or minus 1 percent of span or one scale division, to a maximum of 1.5 percent of span.

B. Thermowells:
1. Manufacturers: Subject to compliance with requirements provide products by one of the following:
   a. TEL-TRU Manufacturing Company: Model 260TW-316 stainless steel.

2. Standard: ASME B40.200.
3. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
4. Type: Stepped shank unless straight or tapered shank is indicated.
5. External Threads: NPS 1/2, NPS 3/4, or NPS 1, or as required to match threaded opening in pipe.
6. Internal Threads: Size and thread type as required to match thermometer mounting threads.
7. Bore: Diameter required to match thermometer bulb or stem.
8. Insertion Length: Length to extend to match thermometer stem length.
9. Lagging Extension: Include on thermowells for insulated piping and tubing. Extension is to be of sufficient length to extend beyond finished insulation surface.
10. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.
11. Heat-Transfer Medium: Mixture of graphite and glycerin.

C. Pressure Gauges, Dial Type, - Direct Mounted, Metal Case:
1. Manufacturers: Subject to compliance with requirements provide products by one of the following:
   a. Weiss Instruments, Inc.: Model TL45P.
2. Source Limitations: Provide dial-type, lead-free, direct-mounted, metal-case pressure gauges from single manufacturer.
3. Standard: ASME B40.100.
4. Case: Liquid-filled sealed type(s); drawn steel; 3-1/2-inch nominal diameter.
5. Pressure-Element Assembly: Bourdon tube.
6. Pressure Connection: Lead-free brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
7. Movement: Mechanical, with link to pressure element and connection to pointer.
8. Dial: Nonreflective aluminum with permanent scale markings graduated in psi.
9. Pointer: Dark-colored metal.
10. Window: Glass.

11. Ring: Metal Brass.
12. Accuracy: Grade B, plus or minus 2 percent of middle half of span.

D. Gauge Attachments:

1. Snubbers: ASME B40.100, lrass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and piston porous-metal-type surge-dampening device. Include extension for use on insulated piping.
2. Valves: brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

E. Test Plugs:
1. Source Limitations: Provide lead-free test plugs from single manufacturer.
2. Description: Test-station fitting made for insertion into piping tee fitting.
3. Body: Lead-free brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
4. Thread Size: NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe thread.
5. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.
6. Core Inserts: EPDM self-sealing rubber.

F. Test-Plug Kits:
1. Source Limitations: Provide lead-free test-plug kits from single manufacturer.
2. Furnish one test-plug kit(s) containing one thermometer(s), one pressure gauge and adapter, and carrying case. Thermometer sensing elements, pressure gauge, and adapter probes are to be of diameter to fit test plugs and of length to project into piping.
3. Low-Range Thermometer, Lead Free: Small, bimetallic insertion type with 1- to 2-inch-diameter dial and tapered-end sensing element. Dial range is to be at least 25 to 125 deg F.
4. High-Range Thermometer, Lead Free: Small, bimetallic insertion type with 1- to 2-inch-diameter dial and tapered-end sensing element. Dial range is to be at least 0 to 220 deg F.
5. Pressure Gauge, Lead Free: Small, lead-free Bourdon-tube insertion type with 2- to 3-inch-diameter dial and probe. Dial range is to be at least 0 to 200 psig.
6. Carrying Case: Metal or plastic, with formed instrument padding.

G. Portable Differential Pressure Meter
1. The Owner shall be furnished a portable differential pressure meter (by RM Cotton – Hydronic equipment provider) complete with case, hoses, disconnects, purge valves suitable for use with all flow indicators and venturous used.

PART 3 - EXECUTION

3.1 INSTALLATION OF EXPANSION JOINTS, GENERAL

A. Install expansion joints of sizes matching sizes of piping in which they are installed.

3.2 INSTALLATION OF PACKLESS EXPANSION JOINTS

A. Install metal-bellows expansion joints in accordance with EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."

B. Install rubber packless expansion joints in accordance with FSA-PSJ-703.

3.3 INSTALLATION OF GROOVED-JOINT EXPANSION JOINTS

A. Install grooved-joint expansion joints to grooved-end steel piping.

3.4 INSTALLATION OF ALIGNMENT GUIDES AND ANCHORS

A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.

B. Install one guide(s) on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.

C. Attach guides to pipe, and secure guides to building structure.

D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

E. Anchor Attachments:

1. Anchor Attachment to Steel Pipe: Attach by welding. Comply with ASME B31.9.
2. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-58, Type 24; U bolts bolted to anchor.

F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.

1. Anchor Attachment to Steel Structural Members: Attach by welding.
2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.
3. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

3.5 INSTALLATION OF PIPE LOOP AND SWING CONNECTIONS

A. Install pipe loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.

B. Connect risers and branch connections to mains with at least five pipe fittings, including tee in main.

C. Connect risers and branch connections to terminal units with at least four pipe fittings, including tee in riser.

D. Connect mains and branch connections to terminal units with at least four pipe fittings, including tee in main.

3.6 INSTALLATION OF SLEEVES - GENERAL

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

1. Sleeves are not required for core-drilled holes.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
2. Cut sleeves to length for mounting flush with both surfaces.

    a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.

3. Using grout or silicone sealant, seal the space outside of sleeves in floors/slabs/walls without sleeve-seal system. Select to maintain fire resistance of floor/slab/wall.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants that joint sealant manufacturer's literature indicates is appropriate for size, depth, and location of joint.

E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping."

3.7 INSTALLATION OF SLEEVES WITH WATERSTOP

A. Install sleeve with waterstop as new walls and slabs are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange centered across width of concrete slab or wall.

C. Secure nailing flanges to wooden concrete forms.

D. Using grout or silicone sealant, seal space around outside of sleeves. Select to maintain fire resistance of floor/slab/wall.

3.8 INSTALLATION OF STACK-SLEEVE FITTINGS

A. Install stack-sleeve fittings in new slabs as slabs are constructed.

1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
5. Using silicone sealant, seal space between top hub of stack-sleeve fitting and pipe.

B. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.9 INSTALLATION OF SLEEVE-SEAL SYSTEMS

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building, and passing through exterior walls.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.10 INSTALLATION OF ESCUTCHEONS

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.

3.11 INSTALLATION OF METERS AND GAUGES

A. Install thermometer with thermowell at each required thermometer location.

B. Install thermowells in vertical position in piping tees.

C. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

D. Install thermowells with extension on insulated piping.

E. Fill thermowells with heat-transfer medium.

F. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

G. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks.

H. Install direct-mounted pressure gauges in piping tees with pressure gauge located on pipe at most readable position.

I. Install remote-mounted pressure gauges on panel.

J. Install valve and snubber in piping for each pressure gauge for fluids.

K. Install test plugs in piping tees.

L. Install thermometers in the following locations:

1. Inlet and outlet of each water heater.

2. Inlets and outlets of each domestic water heat exchanger.
3. Inlet and outlet of each domestic hot-water storage tank.
4. Inlet and outlet of each remote domestic water chiller.
5. Outlet side of hot-water-balancing valve.
6. Each main hot-water-recirculating line return pipe.

M. Install pressure gauges in the following locations:

1. Building water service entrance into building.
2. Inlet and outlet of each pressure-reducing valve.
3. Suction and discharge of each domestic water pump.

3.12 CONNECTIONS

A. Install meters and gauges adjacent to machines and equipment to allow space for service and maintenance of meters, gauges, machines, and equipment.

3.13 ADJUSTING

A. After installation, calibrate meters according to manufacturer's written instructions.

B. Adjust faces of meters and gauges to proper angle for best visibility.

3.14 FIELD QUALITY CONTROL

A. Sleeves and Sleeve Seals:

1. Perform the following tests and inspections:

a. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.
b. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.

2. Prepare test and inspection reports.

B. Escutcheons:

1. Using new materials, replace broken and damaged escutcheons and floor plates.

3.15 SLEEVES APPLICATION

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above and below Grade:

a. Sleeves with waterstops.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

2. Concrete Slabs-on-Grade:

    a. Sleeves with waterstops.

        1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

3. Concrete Slabs above Grade:

    a. Sleeves with waterstops or stack-sleeve fittings.

4. Interior Wall and Partitions:

    a. Sleeves without waterstops.

3.16 ESCUTCHEONS APPLICATION

A. Escutcheons for New Piping and Relocated Existing Piping:

1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
2. Chrome-Plated Piping: One piece, steel cast brass with polished, chrome-plated finish.
3. Insulated Piping:
    a. One piece, cast brass with polished, chrome-plated finish.

4. Bare Piping at Wall and Floor Penetrations in Finished Spaces:
    a. One piece, cast brass with polished, chrome-plated finish.

5. Bare Piping at Ceiling Penetrations in Finished Spaces:
    a. One piece, cast brass with polished, chrome-plated finish.

6. Bare Piping in Unfinished Service Spaces:
    a. One piece, cast brass with polished, chrome-plated finish.

7. Bare Piping in Equipment Rooms:
    a. One piece, cast brass with polished, chrome-plated finish.

B. Install floor plates for piping penetrations of equipment-room floors.

C. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. New Piping and Relocated Existing Piping: One piece, floor plate.
2. Existing Piping: Split floor plate.

3.17 THERMOMETER, LEAD FREE, SCALE-RANGE APPLICATION

A. Scale Range for Domestic Cold-Water Piping:

1. 0 to 100 deg F.

B. Scale Range for Domestic Hot-Water Piping:
1. 20 to 240 deg F 20 to 240 deg F and 0 to 150 deg C.

3.18 PRESSURE-GAUGE SCALE-RANGE APPLICATION

A. Scale Range for Water Service Piping:
   1. 0 to 160 psi.

B. Scale Range for Domestic Water Piping:
   1. 0 to 160 psi.

C. Insert additional paragraphs for pressure-gauge scale ranges and applications.

END OF SECTION 22 0500

SECTION 22 0523

GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Ball valves.
2. Butterfly valves.
3. Check valves.
4. Gate valves.
5. Globe valves.

1.2 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene-diene terpolymer.

C. FKM: Fluoroelastomer.

D. NBR: Nitrile butadiene rubber (also known as Buna-N).

E. NRS: Nonrising stem.

F. OS&Y: Outside screw and yoke.

G. PTFE: Polytetrafluoroethylene.

H. RPTFE: Reinforced polytetrafluoroethylene.

I. RS: Rising stem.

1.3 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.

a. Include material descriptions and dimensions of individual components.
b. Include operating characteristics and furnished accessories.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooved ends, press ends, solder ends, and weld ends.
3. Set ball valves open to minimize exposure of functional surfaces.
4. Set butterfly valves closed or slightly open.
5. Block check valves in either closed or open position.
6. Set gate valves closed to prevent rattling.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems or other components as lifting or rigging points unless specifically indicated for this purpose in manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain each type of valve from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Standards:

1. Domestic-water piping valves intended to convey or dispense water for human consumption must comply with the U.S. Safe Drinking Water Act (SDWA), requirements of authorities having jurisdiction, and NSF 61/NSF 372; or to be certified in compliance with NSF 61/NSF 372 by an American National Standards Institute (ANSI)-accredited third-party certification body, that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

B. ASME Compliance:

1. ASME B1.20.1 for threads for threaded-end valves.
2. ASME B16.1 for flanges on iron valves.
3. ASME B16.5 for flanges on steel valves.
4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
5. ASME B16.18 for cast-copper solder-joint connections.
6. ASME B16.22 for wrought-copper solder-joint connections.
7. ASME B16.34 for flanged- and threaded-end connections.
8. ASME B16.51 for press joint connections.
9. ASME B31.9 for building services piping valves.

C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.

D. Provide bronze valves made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are unacceptable.

E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

F. Valve Sizes: Same as upstream piping unless otherwise indicated.

G. Valve Bypass and Drain Connections: MSS SP-45.

H. Valve Actuator Type:

1. Gear Actuator: For quarter-turn ball valves NPS 4 and larger.
2. Hand Lever: For quarter-turn ball valves smaller than NPS 4.

I. Valves in Insulated Piping:

1. Provide 2-inch extended neck stems.
2. Provide extended operating handles with nonthermal-conductive covering material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
3. Provide memory stops that are fully adjustable after insulation is applied.

2.3 BALL VALVES, GENERAL PURPOSE

A. Ball Valves, Threaded or Soldered Ends - Bronze, Two Piece with Full Port and Stainless-Steel Trim:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Conbraco Industries, Inc.; Apollo Valves
   b. Crane Co.; Crane Valve Group; Crane Valves
2. Standard: MSS SP-110.
3. SWP Rating: 150 psig.
4. CWP Rating: 600 psig.
5. Body Design: Two piece.
6. Body Material: Bronze.
7. Ends: Threaded or soldered. See Part 3 ball valve schedule articles.
8. Seats: PTFE or TFE.
9. Stem: Stainless-steel.
10. Ball: Stainless-steel, vented.
11. Port: Full.

B. Ball Valves, Threaded or Soldered Ends - Brass, Two Piece with Full Port and Stainless Steel Trim:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Conbraco Industries, Inc.; Apollo Valves
   b. Crane Co.; Crane Valve Group; Crane Valves
   c. Kitz Corporation
   d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Standard: MSS SP-110.
3. SWP Rating: 150 psig.
4. CWP Rating: 600 psig.
5. Body Design: Two piece.
6. Body Material: Forged brass.
7. Ends: Threaded or soldered. See Part 3 ball valve schedule articles.
8. Seats: PTFE or TFE.

9. Stem: Stainless steel.
10. Ball: Stainless steel, vented.
11. Port: Full.

C. Ball Valves, True Union 2000 Industrial Type, Full-port, Schedule 80 Thermoplastic.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Spears Manufacturing Company, or equal.
2. All valves shall be manufactured to ASTM F 1970, constructed of PVC Type I, ASTM D 1784 Cell Classification 12454 or CPVC Type IV, ASTM D 1784 Cell Classification 23447.
3. All valves ½" – 2" shall be pressure rated wo 235 PSI, all 2-1/2" valves shall be rated to 150 PSI.
4. Body Design: Two piece.
5. Body Material: PVC/CPVC.
6. Ends: Threaded
7. Seats: EPDM
8. Stem: PVC/CPVC.
9. Ball: PVC/CPVC.
10. Port: Full.

2.4 BUTTERFLY VALVES, GENERAL PURPOSE

A. Butterfly Valves, Single Flange (Lug Type) - Iron, with Aluminum-Bronze Disc:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Kitz Corporation
   b. Milwaukee Valve Company
   c. NIBCO INC.
2. Standard: MSS SP-67, Type I.
3. CWP Rating: 200 psig. See Part 3 butterfly valve schedule articles.
4. Body Design: Single flange (lug type), suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
5. Body Material: ASTM A126, cast iron or ASTM A536, ductile iron.
6. Seat: EPDM.
7. Stem: One- or two-piece stainless steel.
8. Disc: Aluminum bronze.

2.5 CHECK VALVES, GENERAL PURPOSE

A. Check Valves, Swing Type, Threaded or Soldered Ends - Bronze, with Bronze Disc, Class 125:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Conbraco Industries, Inc.; Apollo Valves: Model 161 or approved equal.
2. Standard: MSS SP-80, Type 3.
3. CWP Rating: 200 psig.
4. Body Design: Horizontal flow.
5. Body Material: ASTM B62, bronze.
6. Ends: Threaded. See Part 3 check valve schedule articles.
7. Disc: Bronze.

B. Check Valves, Iron Swing Type, with Metal Seats.:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Conbraco Industries, Inc.; Apollo Valves: Model 910 or approved equal.
2. Standard: MSS SP-71, Type 1.
3. CWP Rating: 200 psig.
4. Body Design: Clear or full waterway.
5. Body Material: ASTM A126, gray iron with bolted bonnet..
6. Ends: Flanged. See Part 3 check valve schedule articles.
7. Trim: Bronze.
8. Gasket: Asbestos free.

2.6 GATE VALVES, GENERAL PURPOSE

A. Gate Valves, Flanged - Bronze, NRS, Class 125:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Kitz Corporation
2. Standard: MSS SP-70, Type 1.
3. CWP Rating: 200 psig.
4. Body Material: ASTM A126, gray iron with bolted bonnet.
5. Ends: Flanged. See Part 3 check valve schedule articles.
6. Trim: Bronze.
7. Gasket: Asbestos free.
8. Disc: Solid wedge, bronze.
9. Packing: Asbestos free.

2.7 GLOBE VALVES, GENERAL PURPOSE

A. Globe Valves, Bronze, Class 125:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Kitz Corporation
2. Standard: MSS SP-80, Type 1.
3. CWP Rating: 200 psig.
4. Body Material: ASTM A126, gray iron with bolted bonnet.
5. Ends: Threaded. See Part 3 check valve schedule articles.
6. Steam and Disc: G/F PTFE
7. Packing: Asbestos free.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Examine press fittings to verify they have been properly pressed.

F. Do not attempt to repair defective valves; replace with new valves. Remove defective valves from site.

3.2 INSTALLATION OF VALVES

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Provide support of piping adjacent to valves such that no force is imposed upon valves.

C. Locate valves for easy access and where not blocked by equipment, other piping, or building components.

D. For valves in horizontal piping, install valves with stem at or above center of pipe.

E. Install valves in position that does not project into aisles or block access to other equipment.

F. Install valves in position to allow full stem and actuator or manual operator movement.

G. Verify that joints of each valve have been properly installed and sealed to assure there is no leakage or damage.

H. Install check valves for proper direction of flow and as follows:

1. Check Valves: Center-guided type and plate type, in horizontal or vertical position, between flanges.
2. Check Valves, Swing Type: In horizontal position with hinge pin level.
3. Check Valves, Lift Type: With stem upright and plumb.

I. Valve Tags: Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

J. Adhere to manufacturer's written installation instructions. When soldering or brazing valves, do not heat valves above maximum permitted temperature. Do not use solder with melting point temperature above valve manufacturer's written recommended maximum.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

B. Select valves with the following end connections:

1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Threaded ends except where solder-joint valve-end option or press-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Copper Tubing, NPS 5 (DN 125) and Larger: Flanged ends.

3.5 DOMESTIC HOT- AND COLD-WATER BALL VALVE SCHEDULE

A. Pipe NPS 2 (DN 50) and Smaller:
1. Ball valves, lead free, threaded or soldered ends - brass, two piece with full port and brass trim; threaded or soldered ends.
2. Ball valves, lead free, threaded or soldered ends - brass, two piece with full port and stainless-steel trim; threaded or soldered ends.

B. Pipe NPS 2-1/2 (DN 65) and Larger:
1. Ball valves, lead free, flanged or threaded ends - steel, with full port, Class 150; flanged or threaded ends.
2. Ball valves, threaded or flanged ends - stainless steel, two piece with full port; threaded flanged ends.

C. POOL FILL VALVE SCHEDULE
1. Valves downstream of pool fill backflow preventor shall be:
   a. Pipe NPS 2-1/2 and Smaller:
      1) Schedule 80 PVC/CPVC ball valves.

END OF SECTION 22 0523

SECTION 22 0529

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe hangers and supports - metal.
2. Pipe hangers - metal, trapeze type.
3. Strut support systems - metal, rod type.
4. Thermal hanger-shield inserts.
5. Fastener systems.
6. Pipe-positioning systems.
7. Equipment supports.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 220500 "Common Work Results for Plumbing" for pipe guides and anchors.
3. Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.

1.2 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers.
2. Metal strut support systems.
3. Rooftop-mounted strut support systems.
4. FRP strut support systems.
5. Pipe stands.
6. Equipment supports.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.4 QUALITY ASSURANCE

A. Structural-Steel Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.

B. Pipe Welding Qualifications: Qualify procedures and operators in accordance with 2021 ASME Boiler and Pressure Vessel Code, Section IX.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Hangers and supports for plumbing piping and equipment are to withstand the effects of gravity loads and stresses within limits and under conditions indicated in accordance with ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
3. Design seismic-restraint hangers and supports for piping and equipment.

2.2 PIPE HANGERS AND SUPPORTS - METAL

A. Pipe Hangers and Supports - Carbon Steel:
1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized, hot-dip galvanized, or electro-galvanized.
3. Nonmetallic Coatings: Plastic coated or epoxy powder coated.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

2.3 PIPE HANGERS - METAL, TRAPEZE TYPE

A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly, made from structural-carbon-steel shapes, with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.4 STRUT SUPPORT SYSTEMS - METAL, ROD TYPE

A. Description: Factory-fabricated pipe-support assembly, made of steel channels, vertical metal support rods, accessories, fittings, and other components for supporting multiple parallel pipes.

B. Standard: Comply with MFMA-4, factory-fabricated components for field assembly.

C. Struts: Continuous slotted carbon-steel channel with inturned lips or angle.

D. Strut Width: Selected for applicable load criteria.

E. Strut Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.

F. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

G. Metallic Coating: Pregalvanized G90.

H. Paint Coating: Green epoxy, acrylic, or urethane.

I. Plastic Coating: PVC.

2.5 THERMAL HANGER-SHIELD INSERTS

A. Insulation-Insert Material for Cold Piping: ASTM C552, Type II cellular glass with 100 psig or ASTM C591, Type VI, Grade 1 polyisocyanurate with 125 psig minimum compressive strength and vapor barrier.

B. Insulation-Insert Material for Hot Piping: Water-repellent-treated, ASTM C533, Type I calcium silicate with 100 psig ASTM C552, Type II cellular glass with 100 psig or ASTM C591, Type VI, Grade 1 polyisocyanurate with 125 psig minimum compressive strength.

C. For Trapeze or Clamped Systems: Insert and shield are to cover entire circumference of pipe.

D. For Clevis or Band Hangers: Insert and shield are to cover bottom 180 degrees of pipe.

E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS

A. Fastener System - Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities required for supported loads and building materials where used.

B. Fastener System - Mechanical-Expansion Anchors: Insert-wedge-type anchors, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities required for supported loads and building materials where used.
   1. Indoor Applications: Zinc-plated or stainless steel.
   2. Outdoor Applications: Stainless steel.

2.7 PIPE-POSITIONING SYSTEMS

A. Description: IAPMO PS 42 positioning system composed of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.8 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-carbon-steel shapes.

2.9 MATERIALS

A. Aluminum: ASTM B221.

B. Carbon Steel: ASTM A1011/A1011M.

C. Structural Steel: ASTM A36/A36M carbon-steel plates, shapes, and bars; black and galvanized.

D. Stainless Steel: ASTM A240/A240M.

E. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000 psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.

B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination is to include weight of supported components plus 200 lb.

3.2 INSTALLATION OF HANGERS AND SUPPORTS

A. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

B. Install lateral bracing with pipe hangers and supports to prevent swaying.

C. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Coordinate location of concrete inserts before concrete is placed.

D. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

E. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

F. Insulated Piping:

1. Attach clamps and spacers to piping.

a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

a. Thermal-hanger shield inserts may be used as an option. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields are to span an arc of 180 degrees.

a. Thermal-hanger shield inserts may be used as an option. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches long and 0.048 inch thick.
b. NPS 4 (DN 100): 12 inches long and 0.06 inch thick.
c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches long and 0.06 inch thick.
d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches long and 0.075 inch thick.
e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches long and 0.105 inch thick.

5. Pipes NPS 8 (DN 200) and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.

G. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

H. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size, or install intermediate supports for smaller-diameter pipes as specified for individual pipe hangers.
2. Field fabricate in accordance with ASTM A36/A36M carbon-steel shapes selected for loads being supported. Weld steel in accordance with AWS D1.1/D1.1M.

I. FRP Pipe-Hanger Installation: Comply with applicable portions of MSS SP-58. Install hangers and attachments as required to properly support piping from building structure.

J. Strut System Installation: Metal; arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

K. Thermal Hanger-Shield Installation: Install in pipe hanger or shield for insulated piping.

L. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick after concrete is placed and cured. Use installers that are licensed by powder-actuated tool manufacturer.

2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners in accordance with manufacturer's written instructions.
3. Install lag screw wood fasteners in accordance with manufacturer's written instructions.
4. Install fasteners in accordance with manufacturer's written instructions.

M. Pipe Stand Installation:

1. Pipe Stand Types, except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for curbs.

N. Pipe-Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.

O. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

P. Equipment Support Installation:

1. Fabricate from welded-structural-steel shapes.
2. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
3. Grouting: Place grout under supports for floor-mounted equipment, and make bearing surface smooth.
4. Provide lateral bracing, to prevent swaying.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections, so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

A. Touchup:

1. Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

    a. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

2. Comply with requirements in Section 099113 "Exterior Painting" Section 099123 "Interior Painting" Section 099600 "High-Performance Coatings" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
3. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A780/A780M.

3.6 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports metal trapeze pipe hangers and metal framing systems and attachments for general service applications.

F. Use stainless steel pipe hangers and FRP strut systems and or corrosion-resistant attachments for hostile environment applications.

G. Use copper-plated pipe hangers and copper or stainless steel attachments for copper piping and tubing.

H. Use padded hangers for piping that is subject to scratching.

I. Use thermal hanger-shield inserts for insulated piping and tubing.

J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.

4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction occurs.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction occurs.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction occurs but vertical adjustment is unnecessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction occurs and vertical adjustment is unnecessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation, in addition to expansion and contraction, is required.

K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment of up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11 split pipe rings.

4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable-Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal Hanger-Shield Inserts: For supporting insulated pipe.

O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.

4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

    a. Horizontal (MSS Type 54): Mounted horizontally.
    b. Vertical (MSS Type 55): Mounted vertically.
    c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

P. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

Q. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

R. Use pipe-positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 22 0529

SECTION 22 0548

VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. All vibration and seismic control for plumbing piping and equipment.
   2. This section shall comply with the requirements and be included as a part of Section 230548 – Vibration and Seismic Controls for HVAC.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage qualified professional structural engineer to prepare seismic-calculations in accordance with criteria specified in Section 018123 "Facility Seismic and Wind Criteria."

B. Provide products that comply with the requirements of Section 230548 – Vibration and Seismic Control for HVAC.

PART 3 - EXECUTION

3.1 EXAMINATION

A. All execution including examination, applications, installations, adjustments, and field quality control shall comply with requirements of Section 230548 – Vibration and Seismic Control for HVAC.

END OF SECTION 22 0548

SECTION 22 0553

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Pipe labels.
3. Stencils.
4. Valve tags.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment-Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve-numbering scheme.

E. Valve Schedules: For each piping system. Include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Outdoor Equipment:
1. Lettering: Stenciled.
2. Minimum Letter Size: 4-inch

B. Plastic Labels for Indoor Equipment:
1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, with predrilled holes for attachment hardware.
2. Letter and Background Color: As indicated for specific application under Part 3.
3. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.
4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
6. Fasteners: Stainless steel rivets or self-tapping screws.

7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

2.2 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color coded, with lettering indicating service and showing flow direction in accordance with ASME A13.1.

B. Letter and Background Color: As indicated for specific application under Part 3.

C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.

D. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

E. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings. Also include:

1. Pipe size.
2. Flow-Direction Arrows: Include flow-direction arrows on main distribution piping. Arrows may be either integral with label or applied separately.
3. Lettering Size: Size letters in accordance with ASME A13.1 for piping.

2.3 STENCILS

A. Stencils for Piping:
1. Lettering Size: Size letters in accordance with ASME A13.1 for piping if not indicated.
2. Stencil Material: Aluminum, brass, or fiberboard.
3. Stencil Paint: Exterior, gloss, alkyd enamel in colors complying with recommendations in ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.
4. Identification Paint: Exterior, alkyd enamel in colors in accordance with ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.
5. Letter and Background Color: As indicated for specific application under Part 3.

2.4 VALVE TAGS

A. Description: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.04-inch minimum thickness, with predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire link chain or beaded chain or S-hook.

B. Letter and Background Color: As indicated for specific application under Part 3.

C. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Include valve-tag schedule in operation and maintenance data.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

3.2 INSTALLATION, GENERAL REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

D. Locate identifying devices so that they are readily visible from the point of normal approach.

3.3 INSTALLATION OF EQUIPMENT LABELS, WARNING SIGNS, AND LABELS

A. Permanently fasten labels on each item of plumbing equipment.

B. Locate equipment labels where accessible and visible.

3.4 INSTALLATION OF PIPE LABELS

A. Install pipe labels showing service and flow direction with permanent adhesive on pipes.

B. Stenciled Pipe Label Option: Stenciled labels showing service and flow direction may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, with painted, color-coded bands or rectangles on each piping system.

1. Identification Paint: Use for contrasting background.
2. Stencil Paint: Use for pipe marking.

C. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Within 3 ft. of each valve and control device.
2. At access doors, manholes, and similar access points that permit view of concealed piping.
3. Within 3 ft. of equipment items and other points of origination and termination.
4. Spaced at maximum intervals of 25 ft. along each run. Reduce intervals to 10 ft. in areas of congested piping and equipment.

D. Do not apply plastic pipe labels or plastic tapes directly to bare pipes conveying fluids at temperatures of 125 deg F or higher. Where these pipes are to remain uninsulated, use a short section of insulation or use stenciled labels.

E. Flow-Direction Flow Arrows: Use arrows, in compliance with ASME A13.1, to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

F. Pipe-Label Color Schedule:
   1. Domestic Cold-Water Piping (Cold, Hot, Recirculating, Non-Potable, Irrigation):
      a. Background Color: White
      b. Letter Color: Black
   2. Natural Gas Piping:
      a. Background Color: White
      b. Letter Color: Black
   3. Heating Water Piping:
      a. Background Color: Yellow
      b. Letter Color: Black
   4. Core Loop Piping:
      a. Background Color: Yellow
      b. Letter Color: Black
   5. Low-Pressure Steam Piping:
      a. Background Color: White
      b. Letter Color: Black

3.5 INSTALLATION OF VALVE TAGS

A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule in the operating and maintenance manual.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below:

   1. Valve-Tag Size and Shape:

      a. Domestic Cold Water: 1-1/2 inches, round.
      b. Domestic Hot Water: 1-1/2 inches, round.
      c. Domestic Hot-Water Return: 1-1/2 inches, round.
      d. Low-Pressure Compressed Air: 1-1/2 inches, round.
      e. Deionized Water Piping: 1-1/2 inches, round.
      f. Distilled Water Piping: 1-1/2 inches, round.
      g. Reverse Osmosis Water Piping: 1-1/2 inches, round.

   2. Valve-Tag Colors:

      a. For each piping system, use the same lettering and background coloring system on valve tags as used in the piping system labels and background.

END OF SECTION 22 0553

SECTION 22 0593

TESTING, ADJUSTING, AND BALANCING FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

A. The Work of this Section Includes:

1. TAB of domestic water system.
2. TAB of plumbing equipment:

    a. Domestic water booster pumps.
    b. Domestic hot-water in-line circulation pumps.
    c. Drainage pumps.

3. Pipe-leakage test verification.

B. Related Requirements:

1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for TAB of HVAC.

1.2 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. FFT: Fast Fourier transform.

C. INCE: Institute of Noise Control Engineering.

D. NC: Noise criteria.

E. NEBB: National Environmental Balancing Bureau.

F. RC: Room criteria.

G. TAB: Testing, adjusting, and balancing.

H. TABB: Testing, Adjusting, and Balancing Bureau.

I. TAB Specialist: An independent entity meeting qualifications to perform TAB work.

J. TDH: Total dynamic head.

1.3 PREINSTALLATION MEETINGS

A. TAB Conference: Conduct a TAB conference at Project site after approval of the TAB strategies and procedures plan, to develop a mutual understanding of the details. Provide a minimum of 14 days' advance notice of scheduled meeting time and location.

1. Minimum Agenda Items:

    a. The Contract Documents examination report.
    b. The TAB plan.
    c. Requirements for coordination and cooperation of trades and subcontractors.
    d. Proposed procedures for documentation and communication flow.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, provide a summary report of the examination review required in "Examination" Article, if issues are discovered that may preclude the proper testing and balancing of the systems. Submit a summary report of the examination review required in "Examination" Article.

C. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures, as specified in "Preparation" Article.

D. System Readiness Checklists: Within 30 days of Contractor's Notice to Proceed, submit system readiness checklists, as specified in "Preparation" Article, to be used and filled out by systems installers verifying that systems are ready for TAB.

E. Certified TAB Reports: Within 14 days of completion of testing and balancing work.

    1. Submit one copy of the final TAB report to the design professional of record's firm. Provide five additional copies to Contractor.

F. Sample report forms.

G. Instrument calibration reports, to include the following:

    1. Instrument type and make.
    2. Serial number.
    3. Application.
    4. Dates of use.
    5. Dates of calibration and calibration interval.

1.5 QUALITY ASSURANCE

A. TAB Specialist Firm's Qualifications, Certified by AABC:

    1. TAB Field Supervisor: Employee of the TAB specialist firm and certified by AABC.
    2. TAB Technician: Employee of the TAB specialist firm and certified by AABC.

B. TAB Specialist Firm's Qualifications: Certified by NEBB or TABB.

    1. TAB Certified Professional: Employee of the TAB specialist firm and certified by NEBB or TABB.
    2. TAB Technician: Employee of the TAB specialist firm and certified by NEBB or TABB.
    3. TAB specialist firm is to be independent, third-party, and unaffiliated with Contractor.

C. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

D. ASHRAE 111 Compliance: Requirements in ASHRAE 111 applicable to analogous domestic water system and plumbing equipment balancing.

E. ASHRAE 188 Compliance: Comply with balancing and report requirements in Section 8.3, "Balancing."

F. Code and Authorities Having Jurisdiction Compliance: Furnish TAB services that comply with governing codes and requirements of authorities having jurisdiction.

1.6 FIELD CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

PART 2 - PRODUCTS
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in system designs that may preclude proper TAB of systems and equipment. Submit Contract Documents Examination Report summary of findings.

B. Examine installed systems for balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, and balancing valves and fittings. Note the locations of devices that are not accessible for TAB.

C. Examine approved submittals for plumbing systems and equipment.

D. Examine system and equipment installations, and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

E. Examine plumbing equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.

F. Verify with installing Contractor that startup strainer screens have been replaced with permanent screens and that all strainers have been cleaned.

G. Examine control valves for proper installation for their intended function of isolating, throttling, diverting, or mixing fluid flows.

H. Observe demonstration of operating safety interlocks and controls on plumbing equipment.

I. Report deficiencies discovered before and during performance of TAB procedures. Observe

and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes the following:

1. Equipment and systems to be tested.
2. Strategies and step-by-step procedures for balancing the systems.
3. Instrumentation to be used.
4. Sample forms with specific identification for all equipment.

B. Prepare system-readiness checklists of plumbing systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:

1. Domestic Water System:

a. Verify leakage and pressure tests on water distribution systems have been completed in accordance with applicable code and authority having jurisdiction.
b. Water heaters are installed and functioning.
c. Piping is complete and all points of outlet are installed.
d. Water treatment is complete.
e. Systems are flushed, filled, and air purged.
f. Strainers are clean.
g. Control valves are functioning in accordance with the sequence of operation.
h. Shutoff and balance valves are 100 percent open.
i. Booster- and hot-water circulating pumps are operational and proper rotation is verified.
j. Pump gauge connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
k. Variable-frequency controllers' startup is complete, and safeties are verified.
l. Suitable access to balancing devices and equipment is provided.

2. Sanitary Sewage/Drainage System:

a. Leakage and pressure tests on sanitary sewage/drainage systems have been completed in accordance with applicable code and authority having jurisdiction requirements.
b. Piping is complete.
c. Sanitary sewage pumps/drainage pumps are operational.
d. Control valves are functioning in accordance with the sequence of operation.
e. Shutoff valves are 100 percent open.
f. Suitable access to equipment is provided.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system in accordance with the procedures contained in AABC's "National Standards for Total System Balance" ASHRAE 111 NEBB's "Procedural Standard for Testing, Adjusting and Balancing of Environmental Systems" SMACNA's "HVAC Systems - Testing, Adjusting & Balancing" SMACNA's "TAB Procedural Guide" applicable to analogous domestic water system and plumbing equipment balancing in this Section.

B. Cut insulation, pipes, and equipment casings for installation of test probes to the minimum extent necessary for TAB procedures.

1. Installing Contractor to Perform the Following:

a. Where holes for probes are required in piping or equipment, install pressure and temperature test plugs to seal systems.
b. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish in accordance with Section 220716 "Plumbing Equipment Insulation" and Section 220719 "Plumbing Piping Insulation."

C. Mark equipment and balancing devices, including valve position indicators and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

E. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.4 GENERAL PROCEDURES FOR PLUMBING EQUIPMENT

A. Test, adjust, and balance plumbing equipment indicated on Drawings, including, but not limited to, the following:

1. Motors.
2. Domestic water booster pumps.
3. Domestic water in-line pumps.
4. Domestic water heaters.
5. Sanitary sewage pumps.
6. Drainage pumps.

3.5 PROCEDURES FOR DOMESTIC WATER SYSTEMS

A. Prepare test reports for pumps and other equipment. Obtain approved submittals and manufacturer-recommended testing procedures. Cross-check the summation of required equipment flow rates with system design flow rates.

B. Prepare schematic diagrams of systems' record Drawings piping layouts.

C. In addition to requirements in "Preparation" Article, prepare domestic water systems for testing and balancing as follows:

1. Check expansion tank for proper setting.
2. Check water heater for proper discharge temperature setting.
3. Check remotest point of outlet for adequate pressure.
4. Check flow-control valves for proper position.
5. Locate start-stop and disconnect switches, electrical interlocks, and motor controllers.
6. Verify that motor controllers are equipped with properly sized thermal protection.
7. Check that air has been purged from the system.

D. Measure and record upstream and downstream pressure of each piece of equipment.

E. Measure and record upstream and downstream pressure of pressure-reducing valves.

F. Check settings and operation of automatic temperature-control valves, self-contained control valves, and pressure-reducing valves. Record final settings.

G. Check settings and operation of each safety valve. Record settings.

3.6 PROCEDURES FOR DOMESTIC HOT-WATER CIRCULATING INLINE PUMP

A. Balance system with manual or automatic balancing valves by setting at design flow.

1. Measure flow in main and branch pipes.
2. Adjust main and branch balance valves for design flow.
3. Re-measure each main and branch after all have been adjusted.

B. Adjust pump to deliver total design flow.

1. Measure pump TDH as follows:

    a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
    b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
    c. Convert pressure to head and correct for differences in gauge heights.
    d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow, and verify that the pump has the intended impeller size.

2. Monitor motor performance during procedures, and do not operate motor in an overloaded condition.
3. Mark final settings and verify that all memory stops have been set.
4. Verify final system conditions as follows:

    a. Re-measure and confirm that total flow is within design.
    b. Re-measure final pumps' operating data, TDH, volts, amps, speed, and static profile.
    c. Mark final settings.

3.7 PROCEDURES FOR MOTORS

A. Motors: 1/2 hp and larger; test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Phase and hertz.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Service factor and frame size.

B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation. Verify and report Hz at maximum and minimum flows.

3.8 PROCEDURES FOR WATER HEATERS

A. Gas- and Oil-Fired Water Heaters:

1. Measure and record entering- and leaving-water temperatures.
2. Measure and record water flow.
3. Measure and record pressure drop.
4. Measure andRecord relief valve(s) pressure setting.
5. Capacity: Calculate in **Btu/h** of heating output.
6. Fuel Consumption: If fuel supply is equipped with flow meter, measure and record consumption.
7. Efficiency: Calculate operating efficiency for comparison to submitted equipment.
8. Fan, motor, and motor controller operating data.

3.9 TOLERANCES

A. Set plumbing system's flow rates within the following tolerances:

1. Domestic Water Flow Rate: Plus or minus 10 percent. If design value is less than **10 gpm**, flow rate is within 10 percent.

3.10 FINAL TESTING AND BALANCING REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.
3. Certify validity and accuracy of field data.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Pump curves.
2. Manufacturers' test data.
3. Field test reports prepared by system and equipment installers.
4. Other information relative to equipment performance; do not include Shop Drawings and product data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB specialist firm and technician.
3. Project name.
4. Project location.
5. Project Architect's name, firm, and address.
6. Project engineer's name, firm, and address.
7. Project Contractor's name, firm, and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents, including the following:

a. Indicated versus final performance.
b. Notable characteristics of systems.
c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.
13. Notes to explain why certain final data in the body of reports vary from indicated values.
14. Test conditions for pump performance forms, including the following:

a. Variable-frequency controller settings for variable-flow hydronic systems.
b. Settings for pressure controller(s).
c. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of distribution systems. Present each system with single-line diagram and include the following:

1. Flow rates.
2. Pipe and valve sizes and locations.
3. Balancing stations.
4. Position of balancing devices.

E. Gas- and Oil-Fired Water Heaters Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:

1. Unit Data:

a. System identification.
b. Location.
c. Make and type.
d. Model number and unit size.
e. Manufacturer's serial number.
f. Fuel type in input data.
g. Output capacity in **Btu/h**.
h. Ignition type.
i. Burner-control types.
j. Motor horsepower and speed.
k. Motor volts, phase, and hertz.
l. Motor full-load amperage and service factor.
m. Sheave make, size in **inches**, and bore.
n. Center-to-center dimensions of sheave and amount of adjustments in **inches**.

2. Test Data (Indicated and Actual Values):

a. Total airflow rate in **cfm**.
b. Entering-water temperature in **deg F**.
c. Leaving-water temperature in **deg F**.
d. Low-fire fuel input in **Btu/h**.
e. High-fire fuel input in **Btu/h**.
f. High-temperature-limit setting in **deg F**.
g. Operating set point in **Btu/h**.
h. Heating value of fuel in **Btu/h**.

F. Electric Water Heater Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:

1. Unit Data:

    a. System identification.
    b. Location.
    c. Model number and unit size.
    d. Manufacturer's serial number.
    e. Output capacity in **Btu/h**.
    f. Number of stages.
    g. Connected volts, phase, and hertz.
    h. Rated amperage.

2. Test Data (Indicated and Actual Values):

    a. Heat output in **Btu/h**.
    b. Entering-water temperature in **deg F**.
    c. Leaving-water temperature in **deg F**.
    d. High-temperature-limit setting in **deg F**.
    e. Operating set point in **deg F**.
    f. Voltage at each connection.
    g. Amperage for each phase.

G. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves, and include the following:

1. Unit Data:

    a. Unit identification.
    b. Location.
    c. Service.
    d. Make and size.
    e. Model number and serial number.
    f. Water flow rate in **gpm**.
    g. Water-pressure differential in **feet of head or psig**.
    h. Required net positive suction head in **feet of head or psig**.
    i. Pump speed.
    j. Impeller diameter in **inches**.
    k. Motor make and frame size.
    l. Motor horsepower and rpm.
    m. Voltage at each connection.
    n. Amperage for each phase.
    o. Full-load amperage and service factor.
    p. Seal type.

2. Test Data (Indicated and Actual Values):

    a. Static head in **feet of head or psig**.
    b. Pump shutoff pressure in **feet of head or psig**.
    c. Actual impeller size in **inches**.
    d. Full-open flow rate in **gpm**.
    e. Full-open pressure in **feet of head or psig**.
    f. Final discharge pressure in **feet of head or psig**.
    g. Final suction pressure in **feet of head or psig**.
    h. Final total pressure in **feet of head or psig**.
    i. Final water flow rate in **gpm**.
    j. Voltage at each connection.
    k. Amperage for each phase.

H. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.11 VERIFICATION OF TAB REPORT

A. The TAB specialist firm's test and balance technician is to conduct the final verification in the presence ofCommissioning Authority.

B. Commissioning Authority are to randomly select measurements, documented in the final report, to be rechecked. Rechecking is to be limited to the lesser of either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.

C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements are to be noted as "FAILED."

D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the TAB are to considered incomplete and are to be rejected.

E. If recheck measurements find the number of failed measurements noncompliant with requirements indicated, proceed as follows:

1. TAB specialists are to recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection. Track all changes to show changes made to previous report.
2. If the second final inspection also fails, Owner may pursue other Contract options to complete TAB Work.

F. Prepare test and inspection reports.

3.12 REVERIFICATION

A. TAB specialist firm technicians are to recheck all measurements and make adjustments as required to complete the balancing. Revise the final report and request a second verification.

3.13 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

END OF SECTION 22 0593

SECTION 22 0719

PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes insulating the following plumbing piping services:

1. Domestic cold-water piping.
2. Domestic hot-water piping.
3. Domestic recirculating hot-water piping.
4. Storm-water piping exposed to freezing conditions.
5. Roof drains and rainwater leaders.
6. Supplies and drains for handicap-accessible lavatories and sinks.

B. Related Sections:

1. Section 220716 "Plumbing Equipment Insulation" for equipment insulation.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties, equipment connections, and access panels.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation system materials are to be delivered to the Project site in unopened containers. The packaging is to include name of the manufacturer, fabricator, type, description, and size, as well as ASTM standard designation and maximum use temperature.

1.6 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.

1. All Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. All Insulation Installed Indoors; Outdoors-Installed Insulation in Contact with Airstream: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
3. All Insulation Installed Indoors and Outdoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2.2 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials are applied.

B. Products do not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come into contact with stainless steel have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.

D. Insulation materials for use on austenitic stainless steel are qualified as acceptable in accordance with ASTM C795.

E. Foam insulation materials do not use CFC or HCFC blowing agents in the manufacturing process.

F. Flexible Elastomeric: Closed-cell or expanded-rubber materials; suitable for maximum use temperature between minus 70 deg F and 220 deg F. Comply with ASTM C534/C534M, Type I for tubular materials.

G. Glass-Fiber, Preformed Pipe: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 850 deg F in accordance with ASTM C411. Comply with ASTM C547.
   1. Preformed Pipe Insulation: Type I, Grade A with factory-applied ASJ.
   2. Fabricated shapes in accordance with ASTM C450 and ASTM C585.
   3. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.3 INSULATING CEMENTS

A. Glass-Fiber and Mineral Wool Insulating Cement: Comply with ASTM C195.

B. Glass-Fiber and Mineral Wool Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C449.

2.4 ADHESIVES

A. Materials are compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Flexible Elastomeric and Polyolefin Adhesive: Solvent-based adhesive.
   1. Flame-spread index is 25 or less and smoke-developed index is 50 or less as tested in accordance with ASTM E84.
   2. Wet Flash Point: Below 0 deg F.
   3. Service Temperature Range: 40 to 200 deg F.
   4. Color: Black.

C. Glass-Fiber and Mineral Wool Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

D. ASJ Adhesive and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A, for bonding insulation jacket lap seams and joints.

E. PVC Jacket Adhesive: Compatible with PVC jacket.

2.5 MASTICS AND COATINGS

A. Materials are compatible with insulation materials, jackets, and substrates.

B. Vapor-Retarder Mastic, Water Based: Suitable for indoor use on below-ambient services.
   1. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
   2. Service Temperature Range: 0 to plus 180 deg F.
   3. Comply with MIL-PRF-19565C, Type II, for permeance requirements.
   4. Color: White.

C. Vapor-Retarder Mastic, Solvent Based, Indoor Use: Suitable for indoor use on below-ambient services.
   1. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
   2. Service Temperature Range: 0 to 180 deg F.
   3. Color: White.

D. Vapor-Retarder Mastic, Solvent Based, Outdoor Use: Suitable for outdoor use on below-ambient services.
   1. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
   2. Service Temperature Range: Minus 50 to plus 220 deg F.
   3. Color: White.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
   1. Water-Vapor Permeance: ASTM E96/E96M, greater than 1.0 perm at manufacturer's recommended dry film thickness.
   2. Service Temperature Range: 0 to plus 180 deg F.
   3. Color: White.

2.6 LAGGING ADHESIVES

A. Adhesives comply with MIL-A-3316C, Class I, Grade A, and are compatible with insulation materials, jackets, and substrates.
   1. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
   2. Service Temperature Range: 0 to plus 180 deg F.
   3. Color: White.

2.7 SEALANTS

A. Materials are as recommended by the insulation manufacturer and are compatible with insulation materials, jackets, and substrates.

B. Joint Sealants:
   1. Permanently flexible, elastomeric sealant.
   2. Service Temperature Range: Minus 58 to plus 176 deg F.
   3. Color: White or gray.

C. FSK and Metal Jacket Flashing Sealants:
   1. Fire- and water-resistant, flexible, elastomeric sealant.
   2. Service Temperature Range: Minus 40 to plus 250 deg F.
   3. Color: Aluminum.

D. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:

1. Fire- and water-resistant, flexible, elastomeric sealant.
2. Service Temperature Range: Minus 40 to plus 250 deg F.
3. Color: White.

2.8 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.
4. ASJ+: Aluminum foil reinforced with glass scrim bonded to a kraft paper interleaving with an outer film leaving no paper exposed; complying with ASTM C1136 Types I, II, III, IV, and VII.
5. PSK Jacket: Aluminum foil fiberglass reinforced scrim with polyethylene backing, complying with ASTM C1136, Type II.

2.9 FIELD-APPLIED JACKETS

A. Field-applied jackets comply with ASTM C1136, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
1. Adhesive: As recommended by jacket material manufacturer.
2. Color: White.
3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

    a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

D. Metal Jacket:
1. Aluminum Jacket: Comply with ASTM B209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.

    a. Sheet and roll stock ready for shop or field sizing.
    b. Finish and thickness are indicated in field-applied jacket schedules.
    c. Moisture Barrier for Indoor Applications: 1-mil-thick, heat-bonded polyethylene and kraft paper.
    d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
    e. Factory-Fabricated Fitting Covers:

        1) Same material, finish, and thickness as jacket.
        2) Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.

3) Tee covers.
4) Flange and union covers.
5) End caps.
6) Beveled collars.
7) Valve covers.
8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

E. Underground Direct-Buried Jacket: 125-mil-thick vapor barrier and waterproofing membrane, consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.

F. Self-Adhesive Outdoor Jacket (Asphaltic): 60-mil-thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a cross-laminated polyethylene film covered with white aluminum-foil facing.

G. Self-Adhesive Indoor/Outdoor Jacket (Non-Asphaltic): Vapor barrier and waterproofing jacket for installation over insulation located aboveground outdoors or indoors. Specialized jacket with five layers of laminated aluminum and polyester film with low-temperature acrylic pressure-sensitive adhesive. Outer aluminum surface is coated with UV-resistant coating for protection from environmental contaminants.
1. Permeance: 0.00 perm as tested in accordance with ASTM F1249.
2. Flamespread/Smoke Developed: 25/50 as tested in accordance with ASTM E84.
3. Aluminum Finish: Embossed.

2.10 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Mesh: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in. for covering pipe and pipe fittings.

B. Woven Polyester Mesh: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for pipe.

2.11 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Cloth: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd..

2.12 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
1. Width: 3 inches.
2. Thickness: 11.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.

1. Width: 3 inches.
2. Thickness: 6.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Width: 2 inches.
2. Thickness: 6 mils.
3. Adhesion: 64 ounces force/inch in width.
4. Elongation: 500 percent.
5. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Width: 2 inches.
2. Thickness: 3.7 mils.
3. Adhesion: 100 ounces force/inch in width.
4. Elongation: 5 percent.
5. Tensile Strength: 34 lbf/inch in width.

2.13 SECUREMENTS

A. Bands:
1. Stainless Steel: ASTM A240/A240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch 3/4 inch wide with wing seal or closed seal.
2. Aluminum: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch 3/4 inch wide with wing seal or closed seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

C. Wire: 0.080-inch nickel-copper alloy.

2.14 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers,:
1. Description: Manufactured plastic wraps for covering plumbing fixture hot-water supply hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

B. Protective Shielding Piping Enclosures,:
1. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range of between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
2. Carbon Steel: Coat carbon steel operating at a service temperature of between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the tradesman installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of pipe system, as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, compress, or otherwise damage insulation or jacket.

D. Install insulation with longitudinal seams at top and bottom (12 o'clock and 6 o'clock positions) of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed in accordance with Contract Documents, unless otherwise approved by the engineer-of-record.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends attached to structure with vapor-barrier mastic.
3. Install insert materials and insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth, but not to the extent of creating wrinkles or areas of compression in the insulation.
2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward-clinching staples along edge at 4 inches o.c.

    a. For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches in similar fashion to butt joints.

P. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials, except where more specific requirements are specified in various pipe insulation material installation articles below.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, Mechanical Couplings, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation made from same material and density as that of adjacent pipe insulation. Each piece is butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation of same material and thickness as that used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers, so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges, mechanical couplings, and unions, using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket, except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing, using PVC tape.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation conforms to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as that of adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least 2 times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe

insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as that of pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install sections of pipe insulation and miter if required in accordance with manufacturer's written instructions.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install prefabricated valve covers manufactured of same material as that of pipe insulation when available.
2. When prefabricated valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 INSTALLATION OF GLASS-FIBER AND MINERAL WOOL INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.

4. For insulation with jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install prefabricated pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with glass-fiber or mineral-wool blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available.
2. When prefabricated insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available.
2. When prefabricated sections are not available, install fabricated sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.8 INSTALLATION OF FIELD-APPLIED JACKETS

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless steel bands 12 inches o.c. and at end joints.

3.9 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless steel jackets.

3.10 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency to perform tests and inspections.

B. Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections with the assistance of a factory-authorized service representative.

E. Tests and Inspections: Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection is limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

F. All insulation applications will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports.

3.11 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.12 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:

1. NPS 1 and Smaller: Insulation is one of the following:
   a. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

2. NPS 1-1/4 and Larger: Insulation is one of the following:
   a. Glass-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inch thick.

B. Domestic Hot and Recirculated Hot Water:

1. NPS 1-1/4 and Smaller: Insulation is one of the following:
   a. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

2. NPS 1-1/2 and Larger: Insulation is one of the following:
   a. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

C. Stormwater and Overflow:

1. All Pipe Sizes: Insulation is one of the following:
   a. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

D. Roof Drain and Overflow Drain Bodies:

1. All Pipe Sizes: Insulation is one of the following:
   a. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

E. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:

1. All Pipe Sizes: Insulation is one of the following:
   a. Glass-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.

F. Sanitary Waste Piping Where Heat Tracing Is Installed:

1. All Pipe Sizes: Insulation is one of the following:
   a. Glass-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches thick.

G. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F:

1. All Pipe Sizes: Insulation is one of the following:

a. Flexible Elastomeric: 3/4 inch thick.
b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

H. Hot Service Drains:

1. All Pipe Sizes: Insulation is one of the following:
a. Glass-Fiber, Preformed Pipe Insulation, Type I: thick.

I. Hot Service Vents:

1. All Pipe Sizes: Insulation is the following:
a. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

3.13 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Domestic Water Piping:

1. All Pipe Sizes: Insulation is one of the following:
a. Glass-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.

B. Domestic Hot and Recirculated Hot Water:

1. All Pipe Sizes: Insulation is the following:
a. Glass-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.

C. Sanitary Waste Piping Where Heat Tracing Is Installed:

1. All Pipe Sizes: Insulation is the following:
a. Glass-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.

3.14 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:

1. None.

D. Piping, Exposed:
1. PVC: 20 mils thick.

E. Piping, that are located above corridors with Techstyle ceilings
1. PVC: 20 mils thick.

3.15 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:

1. None.

D. Piping, Exposed:
1. Aluminum, Stucco Embossed with Z-Shaped Locking Seam: 0.016 inch thick.

3.16 UNDERGROUND, FIELD-APPLIED INSULATION JACKET

A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION 22 0719

SECTION 22 0800

COMMISSIONING OF PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes specific requirements that apply to the implementation of the Commissioning Process and this Division Contractors' participation in this process. This section details the project specific equipment and systems that are included in the Commissioning Process. For general descriptions and responsibilities, refer to SECTION 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

1.2 RELATED DOCUMENTS

A. The Owner's Project Requirements (OPR) document.

B. The Basis of Design (BoD) document.

C. The Project Commissioning Plan (CxP) document.

D. ASHRAE Standard 202-2013 - Commissioning Process for Buildings and Systems.

E. LEED v4 for Building Design and Construction.

1.3 RELATED SECTIONS

A. SECTION 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS

B. SECTION 07 08 00 - COMMISSIONING OF THERMAL AND MOISTURE PROTECTION

C. SECTION 08 08 00 - COMMISSIONING OF OPENINGS

D. SECTION 11 08 00 - COMMISSIONING OF EQUIPMENT

E. SECTION 13 08 00 - COMMISSIONING OF SPECIAL CONSTRUCTION

F. SECTION 14 08 00 - COMMISSIONING OF CONVEYING SYSTEMS

G. SECTION 21 08 00 - COMMISSIONING OF FIRE SUPPRESSION SYSTEMS

H. SECTION 23 08 00 - COMMISSIONING OF MECHANICAL SYSTEMS

I. SECTION 25 08 00 - COMMISSIONING OF INTEGRATED AUTOMATION SYSTEMS

J. SECTION 26 08 00 - COMMISSIONING OF ELECTRICAL SYSTEMS

K. SECTION 27 08 00 - COMMISSIONING OF COMMUNICATIONS SYSTEMS

L. SECTION 28 08 00 - COMMISSIONING OF SAFETY AND SECURITY SYSTEMS

M. SECTION 33 08 00 - COMMISSIONING OF UTILITIES

1.4 DEFINITIONS

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

1.5 RESPONSIBILITIES

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

PART 2 - PRODUCTS

2.1 NO PRODUCTS SUPPLIED

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

B. Contractors and/or Vendors shall provide the specialty testing equipment necessary to fulfill the functional testing requirements, for the duration of the testing period.

PART 3 - EXECUTION

3.1 GENERAL

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.2 MEETINGS

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.3 SYSTEM START-UP

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.4 PRE-FUNCTIONAL CHECKLISTS

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.5 FUNCTIONAL PERFORMANCE TESTING

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.6 TRAINING

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.7 SYSTEMS TO BE COMMISSIONED

A. GENERAL
   1. Commissioning specifications supplement the requirements of individual specifications sections but shall not be interpreted to replace or diminish the specified scope of any individual section.
   2. For all systems listed below, Division Contractor shall comply with all commissioning requirements specified.

B. APPLICABLE SYSTEMS
   1. Meters and Gauges for Plumbing
   2. General-Duty Valves for Plumbing
   3. Hangers and Supports for Plumbing
   4. Identification for Plumbing
   5. Plumbing Insulation
   6. Domestic Water Piping
   7. Domestic Water Piping Specialties
   8. Domestic Water Pumps
   9. Facility Natural-Gas Piping
   10. Sump Pumps
   11. Water Softeners
   12. Gas-Fired Domestic Water Heaters
   13. Plumbing Fixtures
   14. Steam Room Generators
   15. Oil and Grease Interceptors

END OF SECTION 22 0800

SECTION 22 1116

DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper tube and fittings - domestic water.
2. Ductile-iron pipe and fittings - domestic water.
3. Galvanized-steel pipe and fittings - domestic water.
4. PEX tube and fittings - domestic water.
5. PVC pipe and fittings - domestic water.
6. Piping joining materials - domestic water.
7. Transition fittings - domestic water.
8. Dielectric fittings - domestic water.

B. Related Requirements:

1. Section 331415 "Site Water Distribution Piping" for water-service piping and water meters outside the building from source to the point where water-service piping enters the building.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Piping layout, or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.

B. System purging and disinfecting activities report.

C. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Installers of pressure-sealed joints are to be certified by pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.

1.5 FIELD CONDITIONS

A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service in accordance with requirements indicated:

1. Notify Construction Manager no fewer than two days in advance of proposed interruption of water service.
2. Do not interrupt water service without Construction Manager's written permission.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Domestic water piping, tubing, fittings, joints, and appurtenances intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act, with requirements of authorities having jurisdiction, and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2.2 PIPING MATERIALS

A. Potable-water piping and components are to comply with NSF 14, NSF 61, and NSF 372.

2.3 COPPER TUBE AND FITTINGS - DOMESTIC WATER

A. Drawn-Temper Copper Tube: ASTM B88, Type L.

B. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings. Do not use solder joints on pipe sizes greater than NPS 4.

C. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, pressure fittings. Do not use solder joints on pipe sizes greater than NPS 4.

D. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends. Do not use solder joints on pipe sizes greater than NPS 4.

E. Cast Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends. Do not use solder joints on pipe sizes greater than NPS 4.

2.4 DUCTILE-IRON PIPE AND FITTINGS - DOMESTIC WATER

A. Push-on Joint, Ductile-Iron Pipe:

1. AWWA C151/A21.51.
2. Push-on joint bell and plain spigot end unless grooved or flanged ends are indicated.

B. Standard-Pattern, Push-on Joint Fittings:

1. AWWA C110/A21.10, ductile or gray iron.
2. Gaskets: AWWA C111/A21.11, rubber.

C. Compact-Pattern, Push-on Joint Fittings:

1. AWWA C153/A21.53, ductile iron.
2. Gaskets: AWWA C111/A21.11, rubber.

2.5 CPVC PIPING - DOMESTIC WATER (POOL SYSTEMS)

A. Source Limitations: Obtain CPVC piping from single manufacturer.

B. CPVC Pipe: ASTM F441/F441M, with wall thickness as indicated in "Piping Applications" Article.

1. CPVC Socket Fittings: ASTM F439 for Schedule 80.
2. CPVC Threaded Fittings: ASTM F437, Schedule 80.

C. CPVC Piping System: ASTM D2846/D2846M, SDR 11, pipe and socket fittings.

D. CPVC Tubing System: ASTM D2846/D2846M, SDR 11, tube and socket fittings.

2.6 PEX TUBE AND FITTINGS - DOMESTIC WATER

A. PEX Tube - Domestic Water:
1. Acceptable Manufacturer: Uponor
2. Source Limitations: Obtain PEX tube from single manufacturer.
3. Tube Material: PEX plastic in accordance with ASTM F876 and ASTM F877.

B. PEX Tube Fittings - Domestic Water:
1. Source Limitations: Obtain PEX tube fittings from single manufacturer.
2. Fittings: ASTM F1960, cold expansion fittings and reinforcing rings.
3. Push-Fit Fittings: ASSE 1061, push-fit fittings.

C. Manifold: Multiple-outlet, plastic or corrosion-resistant-metal assembly complying with ASTM F876; with plastic or corrosion-resistant-metal valve for each outlet.

2.7 PVC PIPE AND FITTINGS - DOMESTIC WATER

A. PVC Pipe - Domestic Water: ASTM D1785, with wall thickness as indicated in "Piping Applications" Article.
1. Source Limitations: Obtain PVC pipe from single manufacturer.

B. PVC Socket Fittings: ASTM D2467 for Schedule 80.

C. PVC Schedule 80 Threaded Fittings: ASTM D2464.

2.8 PIPING JOINING MATERIALS - DOMESTIC WATER

A. Pipe-Flange Gasket Materials:

1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
2. Full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B32, lead-free alloys.

D. Flux: ASTM B813, water flushable.

E. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

F. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.9 ENCASEMENT FOR PIPING

A. Standard: ASTM A674 or AWWA C105/A21.5.

B. Form: Sheet or tube.

C. Color: Black or natural.

2.10 TRANSITION FITTINGS - DOMESTIC WATER

A. General Requirements:

1. Same size as pipes to be joined.
2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

C. Sleeve-Type Transition Couplings - Domestic Water: AWWA C219.
1. Source Limitations: Obtain sleeve-type transition couplings from single manufacturer.

D. Plastic-to-Metal Transition Fittings - Domestic Water:
1. Source Limitations: Obtain plastic-to-metal transition fittings from single source.
2. Description:

a. CPVC or PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions.
b. One end with threaded brass insert and one solvent-cement-socket or threaded end.

E. Plastic-to-Metal Transition Unions - Domestic Water:
1. Source Limitations: Obtain plastic-to-metal transition unions from single manufacturer.
2. Description:

a. CPVC or PVC four-part union.
b. Brass or stainless steel threaded end.

c. Solvent-cement-joint or threaded plastic end.
d. Rubber O-ring.
e. Union nut.

2.11 DIELECTRIC FITTINGS - DOMESTIC WATER

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions - Domestic Water:
1. Source Limitations: Obtain dielectric unions from single manufacturer.
2. Standard: ASSE 1079.
3. Pressure Rating: 125 psig minimum at 180 deg F.
4. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges - Domestic Water:
1. Source Limitations: Obtain dielectric flanges from single manufacturer.
2. Standard: ASSE 1079.
3. Factory-fabricated, bolted, companion-flange assembly.
4. Pressure Rating: 125 psig minimum at 180 deg F.
5. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits - Domestic Water:
1. Source Limitations: Obtain dielectric-flange insulating kits from single manufacturer.
2. Nonconducting materials for field assembly of companion flanges.
3. Pressure Rating: 150 psig.
4. Gasket: Phenolic, Temperature Rating: 225 deg F.
5. Bolt Sleeves: Phenolic or polyethylene.
6. Washers: Phenolic with steel backing washers.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.

D. Under-building-slab, domestic water, building-service piping, is to be the following:
1. Push-on joint, ductile-iron pipe; standard-pattern, push-on joint fittings; and gasketed joints.

E. Under-building-slab, domestic water piping, NPS 2 (DN 50) and smaller is to be the following:

1. Annealed-temper copper tube, ASTM B88, Type K; cast-copper, solder-joint fittings; and brazed joints.

F. Aboveground domestic water piping, NPS 2 (DN 50) and smaller is to be the following:
   1. Drawn-temper copper tube, ASTM B88, Type L; cast-copper, solder-joint fittings; and soldered joints.
   2. PEX tube, NPS 2 and smaller.

      a. Fittings for PEX tube:

         1) ASTM F1807, metal insert and copper crimp rings.
         2) ASTM F1960, cold expansion fittings and reinforcing rings.
         3) ASSE 1061, push-fit fittings.

G. Aboveground domestic water piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100) is to be the following:

   1. Drawn-temper copper tube, ASTM B88, Type L; cast-copper, solder-joint fittings; and soldered joints.

3.2 EARTHWORK

A. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

3.3 INSTALLATION OF PIPING

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install copper tubing under building slab in accordance with CDA's "Copper Tube Handbook."

C. Install ductile-iron piping under building slab with restrained joints in accordance with AWWA C600 and AWWA M41.

D. Install underground copper tube and ductile-iron pipe in PE encasement in accordance with ASTM A674 or AWWA C105/A21.5.

E. Install valves in accordance with Section 220523 "General-Duty Valves for Plumbing Piping."

F. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 221119 "Domestic Water Piping Specialties."

G. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.

H. Rough-in domestic water piping for water-meter installation in accordance with utility company's requirements.

I. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

J. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

K. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

L. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

M. Install piping to permit valve servicing.

N. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

O. Install piping free of sags and bends.

P. Install fittings for changes in direction and branch connections.

Q. Install PEX tube with loop at each change of direction of more than 90 degrees.

R. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

S. Install pressure gauges on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gauges in Section 220500 "Common Work Results for Plumbing."

T. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 221123.21 "Inline, Domestic Water Pumps."

U. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Section 220500 "Common Work Results for Plumbing."

V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220500 "Common Work Results for Plumbing."

W. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220500 "Common Work Results for Plumbing."

X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220500 "Common Work Results for Plumbing."

3.4 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads in accordance with ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.

E. Soldered Joints for Copper Tubing: Apply ASTM B813, water-flushable flux to end of tube. Join copper tube and fittings in accordance with ASTM B828 or CDA's "Copper Tube Handbook."

F. Push-on Joints for Copper Tubing: Clean end of tube. Measure insertion depth with manufacturer's depth gage. Join copper tube and push-on joint fittings by inserting tube to measured depth.

G. Extruded-Tee Connections: Form tee in copper tube in accordance with ASTM F2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.

H. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts in accordance with ASME B31.9.

I. Joint Construction for Solvent-Cemented Plastic Piping: Clean and dry joining surfaces. Join pipe and fittings in accordance with the following:

1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
2. CPVC Piping: Join in accordance with ASTM D2846/D2846M.
3. PVC Piping: Join in accordance with ASTM D2855.

J. Joints for PEX Tubing, ASTM: Join in accordance with ASTM F1807 for metal insert and copper crimp ring fittings and ASTM F1960 for cold expansion fittings and reinforcing rings.

K. Joints for PEX Tubing, ASSE: Join in accordance with ASSE 1061 for push-fit fittings.

L. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.5 INSTALLATION OF TRANSITION FITTINGS

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:

1. Fittings for NPS 1-1/2 (DN 40) and Smaller: Fitting-type coupling.
2. Fittings for NPS 2 (DN 50) and Larger: Sleeve-type coupling.

C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 (DN 50) and Smaller: Plastic-to-metal transition fittings or unions.

3.6 INSTALLATION OF DIELECTRIC FITTINGS

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 (DN 50) and Smaller: Use dielectric couplings or unions.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Use dielectric flanges.

D. Dielectric Fittings for NPS 5 (DN 125) and Larger: Use dielectric flange kits.

3.7 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for hangers, supports, and anchor devices in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

C. Install hangers for copper and ductile iron pipe, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

D. Install vinyl-coated hangers for CPVC and PVC pipe, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

E. Install vinyl-coated hangers for PEX tube, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

F. Support horizontal piping within 12 inches of each fitting.

G. Support vertical runs of copper and ductile iron pipe to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

H. Support vertical runs of CPVC and PVC pipe to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

I. Support vertical runs of PEX tube to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.8 PIPING CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.

2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
3. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
4. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.9 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."

3.10 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:

    a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    b. Fill and isolate system in accordance with either of the following:

        1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
        2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

    c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
    d. Repeat procedures if biological examination shows contamination.
    e. Submit water samples in sterile bottles to authorities having jurisdiction.

B. Clean non-potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:

    a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.11 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.

    a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
    b. Adjust calibrated balancing valves to flows indicated.

5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.12 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Piping Inspections:

    a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
    b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

        1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after installation and before setting fixtures.
        2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.

    c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
    d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Piping Tests:

    a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
    b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
    c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.

d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
e. Hydrostatic testing and documentation of test results for polypropylene (PP-R and PP-RCT) pipe to be in accordance with manufacturer's written instructions and submitted to manufacturer upon successful completion per warranty requirements.
f. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
g. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 22 1116

SECTION 22 1119

DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Automatic water shutoff valve systems.
5. Balancing valves.
6. Temperature-actuated, water mixing valves.
7. Strainers for domestic water piping.
8. Hose bibbs.
9. Wall hydrants.
10. Drain valves.
11. Water-hammer arresters.
12. Trap-seal primer device.
13. Trap-seal primer systems.
14. Flexible connectors.

B. Related Requirements:

1. Section 220500 "Common Work Results for Plumbing."
2. Section 224700 "Drinking Fountains and Water Coolers."
3. Section 331415 "Site Water Distribution Piping" for fire water-service backflow prevention devices.

1.2 DEFINITIONS

A. AMI: Advanced Metering Infrastructure.

B. AMR: Automatic Meter Reading.

C. FKM: A family of fluoroelastomer materials defined by ASTM D1418.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For domestic water piping specialties.

1. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Test and inspection reports.

B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

A. Domestic water piping specialties intended to convey or dispense water for human consumption are to comply with the SDWA, requirements of authorities having jurisdiction, and NSF 61 and NSF 372, or to be certified in compliance with NSF 61 and NSF 372 by an American National Standards Institute (ANSI)-accredited third-party certification body that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2.2 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.3 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. American Standard: Model HB-15755
      b. Conbraco Industries, Inc.
      c. Watts Industries, Inc.; Water Products Div.
   2. Standard: ASSE 1001.
   3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
   4. Body: Bronze.
   5. Inlet and Outlet Connections: Threaded.
   6. Finish: Chrome plated.

B. Hose-Connection Vacuum Breakers:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Conbraco Industries, Inc.
      b. Watts Industries, Inc.; Water Products Div.
      c. Woodford Manufacturing Company, Inc.
   2. Standard: ASSE 1011.
   3. Body: Bronze, nonremovable, with manual drain.
   4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
   5. Finish: Rough bronze.

2.4 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers (RPZ):
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Watts Industries, Inc.; Water Products Div. – Models LF919-QT and 957-NRS
   2. Standard: ASSE 1013.
   3. Operation: Continuous-pressure applications.
   4. Pressure Loss: 12 psig maximum, through middle third of flow range.
   5. Body: Bronze for NPS 2 and smaller; ductile or cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
   6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
   7. Configuration: Designed for horizontal, straight-through flow.
   8. Accessories:

      a. Valves NPS 2 (DN 50) and Smaller: Ball type with threaded ends on inlet and outlet.
      b. Valves NPS 2-1/2 (DN 65) and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
      c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

B. Double-Check, Backflow-Prevention Assemblies (DCVA):
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Watts Industries, Inc.; Water Products Div. – Models LF919-QT and 757-NRS
   2. Standard: ASSE 1015.
   3. Operation: Continuous-pressure applications unless otherwise indicated.
   4. Body: Bronze for NPS 2 and smaller; ductile or cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
   5. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
   6. Configuration: Designed for horizontal, straight-through flow.
   7. Accessories:

      a. Valves NPS 2 (DN 50) and Smaller: Ball type with threaded ends on inlet and outlet.
      b. Valves NPS 2-1/2 (DN 65) and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.

C. Beverage-Dispensing-Equipment Backflow Preventers:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Watts Industries, Inc.; Water Products Div. – Models 3D with strainer.
   2. Standard: ASSE 1022.
   3. Operation: Continuous-pressure applications.
   4. Body: Stainless steel or non-metallic with union in inlet.

D. Dual-Check-Valve Backflow Preventers:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Watts Industries, Inc.; Water Products Div. – Models series 7.
   2. Standard: ASSE 1024.
   3. Operation: Continuous-pressure applications.
   4. Body: Bronze with union inlet.

E. High Pressure Hose-Connection Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Watts Industries, Inc.; Water Products Div. – Models 912HP.
2. Operation: Protects against back pressure and back siphonage.
3. Pressure Loss: 10 psig maximum, though middle 1/3 of flow range.
4. Body: ASTM B-584 bronze.
5. End Connections: Threaded.
6. Configuration: Designed for horizontal and vertical straight through flow.
7. Accessories: Vent and drain.

F. Backflow-Preventer Test Kits:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Watts Industries, Inc.; Water Products Div.
2. Description: Factory calibrated, with gauges, fittings, hoses, and carrying case with test-procedure instructions.

2.5 WATER PRESSURE-REDUCING VALVES

A. Water Regulators:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Watts Industries, Inc.; Water Products Div.
2. Standard: ASSE 1003.
3. Pressure Rating: Initial working pressure of 150 psig.
4. Size: NPS 3
5. Design Flow Rate: 50 to 150 gpm.
6. Design Inlet Pressure: As indicated on plans.
7. Design Outlet Pressure Setting: As indicated on plans.
8. Body: Bronze with chrome-plated finish for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.
9. Valves for Booster Heater Water Supply: Include integral bypass.
10. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.

B. Pool Fill Regulators:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Watts Industries, Inc.; Water Products Div. – Models 3D with strainer.
2. Standard: ASSE 1003.
3. Primary Valve:
   a. Model: Watts LFN223B
   b. Size: NPT 2-1/2
   c. Adjustable Reduced Pressure Range of 25-75 psi.
4. Design Inlet Pressure: As indicated on plans.
5. Design Outlet Pressure Setting: As indicated on plans.
6. Body: Lead free cast copper silicon alloy.
7. End Connections: Threaded for NPS 2-1/2 and smaller.

2.6 BALANCING VALVES

A. Thermostatic Circuit Balancing Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Circuit Solver, by Therm Omega Tech, CSUAS-3/4-XXX-CV1, no exceptions.

2. Standards: NSF/ANSI 61 Certified, CA Health and Safey Code 116875
3. Pressure Rating : 200 psig.
4. Size: NPS 2 or smaller.
5. Body: 303 stainless steel construction.
6. Thermal modulating valve internal components: Valve plug, thermal actuator and carrier are 303 stainless steel, spring is 302 stainless steel.
7. End Connections: Threaded.

2.7 DRAIN TEMPERING VALVES

A. Thermostatic Drain Tempering Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. DTV, by Therm Omega Tech, no exceptions.
2. Self-activated tempering valve for steam generators and dish machine drains to limit the drain effluent into the sanitary sewer system below the maximum allowable temperature of 140 degrees F.
3. Provide cold water connection with backflow protection and water hammer arrestor according to the manufacturers' install instructions. The discharge temperature of the valve shall be set to 140 degrees F.

2.8 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Primary, Thermostatic, Water Mixing Valves:
1. Materials covered in this article are to be purchased direct from the supplier.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Lawler – Neptune EMX 200-943040 Electron Mixing Valve.
3. The plumbing contractor shall pipe the valve according to the manufacturers' installation instructions. The discharge temperature of the valve shall be set to 120 degrees F.

B. Point-of-Use, Thermostatic Water Mixing Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Lawler – TMM-1070, part #87500.
2. The plumbing contractor shall furnish and install point-of-use thermostatic mixing valves under each lavatory and hand sink in Childcare, Family Locker Room, Men's locker room, Women's locker room, pool toilets, Café, Bistro, Bar and as shown on the drawings. The plumbing contractor shall pipe the valve according to the manufacturer's installation instructions. The discharge temperature of the valve shall be set to 100 degrees F.

2.9 STRAINERS FOR DOMESTIC WATER PIPING

A.

B. Y-Pattern Strainers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Spence Strainers International.
2. Pressure Rating: 125 psig minimum unless otherwise indicated.

3. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 and larger.
4. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
5. Screen: Stainless steel with round perforations unless otherwise indicated.
6. Perforation Size:

    a. Strainers NPS 2 (DN 50) and Smaller: 0.020 inch.
    b. Strainers NPS 2-1/2 to NPS 4 (DN 65 to DN 100): 0.045 inch.
    c. Strainers NPS 5 (DN 125) and Larger: 0.10 inch.

7. Drain: Pipe plug.

2.10 HOSE BIBBS

A. Interior Wall Hydrants (Finished Areas):
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Watts HY-330.
2. Standard: ASME A112.18.1 for sediment faucets.
3. Body Material: Stainless Steel.
4. Seat: Bronze, replaceable.
5. Supply Connections: NPS 3/4 threaded or solder-joint inlet.
6. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
7. Pressure Rating: 125 psig.
8. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1052.
9. Finish for Finished Rooms: Smooth polished chrome plated finish, recessed head in stainless steel wall box with smooth polished chrome face and cover for narrow wall construction.
10. Operation for Finished Rooms: Operating key. Include operating key with each operating-key hose bibb.
11. Mounting for Finished Rooms: Recessed, stainless steel wall box with chrome face/cover for narrow wall construction.

B. Hose Bibbs (Non-Finished Areas):
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Woodford - model 26P.
    b. Watts Industries, Inc.; Water Products, Div.,
2. Standard: ASME A112.18.1 for sediment faucets.
3. Body Material: Bronze.
4. Seat: Bronze, replaceable.
5. Supply Connections: NPS 3/4 threaded or solder-joint inlet.
6. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
7. Pressure Rating: 125 psig.
8. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
9. Finish for Equipment Rooms: Rough bronze.
10. Finish for Service Areas: Rough bronze.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Wheel handle.

2.11 WALL HYDRANTS

A. Nonfreeze Vacuum Breaker Wall Hydrants:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Woodford - model B67.
      b. Wade – model 8600.
   2. Standard: ASSE 1019, Type A or Type B.
   3. Type: Automatic draining with integral air-inlet valve.
   4. Classification: Type B, for automatic draining with hose removed or with hose attached and nozzle closed.
   5. Pressure Rating: 125 psig.
   6. Operation: Loose key.
   7. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
   8. Inlet: NPS 3/4.
   9. Outlet: Exposed with garden-hose thread complying with ASME B1.20.7.
   10. Box: Deep, flush mounting with cover.
   11. Box and Cover Finish: Polished nickel bronze.
   12. Operating Keys: One with each wall hydrant.

2.12 ROOF HYDRANTS

A. Vacuum Breaker Wall Hydrants (HY-3):
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Woodford: Model SRH-MS
   2. Standard: ASSE 1057.
   3. Type: Freeze-resistant, automatic draining with venturi action.
   4. Classification: Type B, for automatic draining with hose removed or with hose attached and nozzle closed.
   5. Pressure Rating: 100 psig (860 kPa).
   6. Vacuum Breaker: 50H-BR, drainable, hose-connection vacuum breaker complying with
   7. ASSE 1052. In event of failure, the vacuum break it is to be replaced with like equal to ensure venturi action can still be performed while vacuum breaker is attached.
   8. Operation: Loose key.
   9. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp. Inlet: NPS 3/4.

B. Nonfreeze, Draining-Type Roof Hydrants:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Woodford - model RHY2.
      b. Wade – model 8610.
   2. Standard: ASSE 1019, Type B.
   3. Type: Nonfreeze, automatic draining with hose removed or with hose attached and nozzle closed.
   4. Pressure Rating: 125 psig.
   5. Casing and Operating Rod: Bronze interior parts, galvanized-steel casing, and bronze valve housing designed with hole to drain.
   6. Inlet: NPS 3/4.
   7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread comply with ASME B1.20.7.
   8. Vacuum Breaker:

a. Nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052.

2.13 YARD HYDRANTS

A. Vacuum Breaker Yard Hydrants:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Woodford – model Y95.
   b. Wade – model 8602.
2. Standard: ASSE 1019, Type B.
3. Type: Nonfreeze, with 4 feet bury depth, with automatic drain down.
4. Pressure Rating: 125 psig.
5. Vacuum Breaker: Anti siphon NIDEL 34HW, integral nonremovable, drainable, hoe-connection vacuum breaker complying with ASSE 1011.
6. Casing and Operating Rod: 3/8” galvanized steel pipe, 2 feet minimum length required.
7. Inlet: NPS 3/4.
8. Outlet: Concealed, with integral vacuum breaker and garden-hose thread comply with ASME B1.20.7.
9. Box: Deep, flush mounting with cover.
10. Box and Cover Finish: Brass casting.
11. Operating Keys: One with each wall hydrant.

2.14 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.15 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Sioux Chief Manufacturing Company
   b. Precision Plumbing Products.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Piston with EPDM O-rings.
4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.16 TRAP-SEAL PRIMER DEVICE

A. Supply-Type, Trap-Seal Primer Device:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Sioux Chief Manufacturing Company: Model 695.
      b. Precision Plumbing Products: Model P2-500.
   2. Standard: ASSE 1018.
   3. Pressure Rating: 125 psig minimum.
   4. Body: Bronze.
   5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
   6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
   7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING SPECIALTIES

A. Backflow Preventers: Install in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.

   1. Locate backflow preventers in same room as connected equipment or system.
   2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
   3. Do not install bypass piping around backflow preventers.

B. Water Regulators: Install with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gauges on inlet and outlet.

C. Water Control Valves: Install with inlet and outlet shutoff valves and bypass with globe valve. Install pressure gauges on inlet and outlet.

D. Automatic Water Shutoff Valves: Test for signal strength before valve installation. Install automatic shutoff valve downstream from main domestic water shutoff valve. Install valve controller in an accessible location with sensors in areas where water is likely to accumulate.

E. Balancing Valves: Install in locations where they can easily be adjusted. Set at indicated design flow rates.

F. Temperature-Actuated, Water Mixing Valves: Install with check stops or shutoff valves on inlets and with shutoff valve on outlet.

   1. Install cabinet-type units recessed in or surface mounted on wall as specified.

G. Y-Pattern Strainers: For water, install on supply side of each control valve water pressure-reducing valve solenoid valve and pump.

H. Outlet Boxes: Install boxes recessed in wall or surface mounted on wall. Install 1-1/2-by-3-1/2-inch fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 061000 "Rough Carpentry."

I. Hose Stations: Install with check stops or shutoff valves on inlets and with thermometer on outlet.

1. Install cabinet-type units recessed in or surface mounted on wall as specified. Install 1-1/2-by-3-1/2-inch fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 061000 "Rough Carpentry."

J. Ground Hydrants: Install with 1 cu. yd. of crushed gravel around drain hole. Set ground hydrants with box flush with grade.

K. Nonfreeze, Draining-Type Post Hydrants: Install with 1 cu. yd. of crushed gravel around drain hole. Set post hydrants in concrete paving or in 1 cu. ft. of concrete block at grade.

L. Nonfreeze, Nondraining-Type Post Hydrants: Set in concrete or pavement.

M. Nonfreeze, Sanitary Yard Hydrants: Set with riser pipe in concrete or pavement. Do not encase canister in concrete.

N. Nonfreeze, Draining-Type Roof Hydrants: Install with drain connection piped to nearest floor drain or to the exterior.

O. Water-Hammer Arresters: Install in water piping in accordance with PDI-WH 201.

P. Supply-Type, Trap-Seal Primer Device: Install with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

Q. Drainage-Type, Trap-Seal Primer Device: Install as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.

R. Trap-Seal Primer Systems: Install with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.

3.2 PIPING CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping specialties adjacent to equipment and machines, allow space for service and maintenance.

3.3 ELECTRICAL CONNECTIONS

A. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.

3.4 CONTROL CONNECTIONS

A. Connect control wiring in accordance with Section 260523 "Control-Voltage Electrical Power Cables."

3.5 IDENTIFICATION

A. Plastic Labels for Equipment: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Automatic water shutoff valve systems.
5. Balancing valves.
6. Temperature-actuated, water mixing valves.
7. Outlet boxes.
8. Hose stations.
9. Wall hydrants.
10. Ground hydrants.
11. Post hydrants.
12. Roof hydrants.
13. Trap-seal primer device.
14. Trap-seal primer systems.
15. Water meters.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.6 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow set points of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

D. Adjust each pressure vacuum breaker reduced-pressure-principle backflow preventer double-check, backflow-prevention assembly and double-check, detector-assembly backflow preventer in accordance with manufacturer's written instructions, authorities having jurisdiction and the device's reference standard.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative.

1. Test each pressure vacuum breaker reduced-pressure-principle backflow preventer double-check, backflow-prevention assembly and double-check, detector-assembly backflow preventer according to authorities having jurisdiction and the device's reference standard.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

END OF SECTION 22 1119

SECTION 22 1123.21

INLINE, DOMESTIC-WATER PUMPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. In-line, sealless centrifugal pumps.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction materials, rated capacities, certified performance curves with operating points plotted on curves, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Detail pumps and adjacent equipment. Show support locations, type of support, weight on each support, required clearances, and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Structural members to which pumps will be attached.
2. Size and location of initial access modules for acoustical tile.

B. Seismic Qualification Data: Certificates, for inline, domestic-water pumps, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For inline, domestic-water pumps to include in operation and maintenance manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Retain shipping flange protective covers and protective coatings during storage.

B. Protect bearings and couplings against damage.

C. Comply with pump manufacturer's written instructions for handling.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. UL Compliance: UL 778 for motor-operated water pumps.

C. Drinking Water System Components - Health Effects and Drinking Water System Components - Lead Content Compliance: NSF 61 and NSF 372.

2.2 IN-LINE, SEALLESS CENTRIFUGAL PUMPS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. TACO Incorporated

B. Description: Factory-assembled and -tested, in-line, close-coupled, canned-motor, sealless, overhung-impeller centrifugal pumps.

C. Pump Construction:

   1. Pump and Motor Assembly: Hermetically sealed, replaceable-cartridge type with motor and impeller on common shaft and designed for installation with pump and motor shaft horizontal.
   2. Casing: Bronze, with threaded or companion-flange connections.
   3. Motor: Single speed.

2.3 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 220500 "Common Work Results for Plumbing."

   1. Motor Sizes: Minimum size as indicated. If not indicated, large enough driven load will not require motor to operate in service factor range above 1.0.

2.4 CONTROLS

A. Thermostats: Electric; adjustable for control of hot-water circulation pump.

1. Type: Water-immersion temperature sensor, for installation in piping.
2. Range: 65 to 200 deg F.
3. Enclosure: NEMA 250,.
4. Operation of Pump: On or off.
5. Transformer: Provide if required.
6. Power Requirement: 120 V ac.
7. Settings: Start pump at 105 deg F and stop pump at 115 deg F.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for domestic-water-piping system to verify actual locations of piping connections before pump installation.

3.2 INSTALLATION OF PUMPS

A. Comply with HI 1.4.

B. Mount pumps in orientation complying with manufacturer's written instructions.

C. Pump Mounting:
1. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.

D. Install continuous-thread hanger rods and vibration isolation of size required to support pump weight.

1. Comply with requirements for vibration isolation devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment." Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment." Fabricate brackets or supports as required.
2. Comply with requirements for hangers and supports specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

E. Install thermostats in hot-water return piping.

3.3 PIPING CONNECTIONS

A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to inline, domestic-water pumps, allow space for service and maintenance.

C. Connect domestic-water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles.

1. Install flexible connectors adjacent to pumps in suction and discharge piping of the following pumps:

a. Horizontally mounted, in-line, close-coupled centrifugal pumps.

D. Install shutoff valve and strainer on suction side of each pump, and check, shutoff, and throttling valves on discharge side of each pump. Install valves same size as connected piping. Comply with requirements for strainers specified in Section 221119 "Domestic Water Piping Specialties." Comply with requirements for valves specified in Section 220523 "General-Duty Valves for Plumbing Piping."

1. Install pressure gauge and snubber at suction of each pump and pressure gauge and snubber at discharge of each pump. Install at integral pressure-gauge tappings where provided or install pressure-gauge connectors in suction and discharge piping around pumps. Comply with requirements for pressure gauges and snubbers specified in Section 220500 "Common Work Results for Plumbing."

3.4 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring between temperature controllers and devices.

C. Interlock pump between water heater and hot-water storage tank with water heater burner and time-delay relay.

3.5 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment" for identification of pumps.

3.6 FIELD QUALITY CONTROL

A. Testing Agency:

1. Owner will engage a qualified testing agency to perform tests and inspections.
2. Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

D. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Inline, domestic-water pump will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

3.7 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Check piping connections for tightness.
3. Clean strainers on suction piping.
4. Set thermostats, for automatic starting and stopping operation of pumps.
5. Perform the following startup checks for each pump before starting:

    a. Verify bearing lubrication.
    b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
    c. Verify that pump is rotating in the correct direction.

6. Prime pump by opening suction valves and closing drains and prepare pump for operation.
7. Start motor.
8. Open discharge valve slowly.
9. Adjust temperature settings on thermostats.
10. Adjust timer settings.

3.8 ADJUSTING

A. Adjust inline, domestic-water pumps to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust initial temperature set points.

C. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

END OF SECTION 22 1123.21

SECTION 22 1316

SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Hubless, cast-iron soil pipe and fittings.
   2. PVC pipe and fittings.
   3. Specialty pipe fittings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans and elevations or Building Information Model (BIM) drawn to scale, showing items described in this Section and coordinated with all building trades.

B. Seismic Qualification Certificates: For waste and vent piping, accessories, and components, from manufacturer.

   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Detailed description of piping anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

1.4 FIELD CONDITIONS

A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service in accordance with requirements indicated:

   1. Notify Owner no fewer than two days in advance of proposed interruption of sanitary waste service.
   2. Do not proceed with interruption of sanitary waste service without Owner's written permission.

1.5 WARRANTY

A. Listed manufacturers to provide labeling and warranty of their respective products.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Components and installation are capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10 ft. head of water.

2.2 PIPING MATERIALS

A. Piping materials to bear label, stamp, or other markings of specified testing agency.

B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings:

1. Marked with CISPI collective trademark.
2. ASTM A888 or CISPI 301.

B. CISPI, Hubless-Piping Couplings:
1. Standards: ASTM C1277 and CISPI 310.
2. Description: Stainless steel corrugated shield with stainless steel bands and tightening devices; and ASTM C564, rubber sleeve with integral, center pipe stop.

C. Heavy-Duty, Hubless-Piping Couplings:
1. Standards: ASTM C1277 and ASTM C1540..
2. Description: Stainless steel shield with stainless steel bands and tightening devices; and ASTM C564, rubber sleeve with integral, center pipe stop.

2.4 PVC PIPE AND FITTINGS

A. Comply with NSF 14 for plastic piping components. Include "NSF-dwv" marking for plastic drain, waste, and vent piping and "NSF-sewer" marking for plastic sewer piping.

B. Solid-Wall PVC Pipe: ASTM D2665 drain, waste, and vent.

C. PVC Socket Fittings: ASTM D2665, made in accordance with ASTM D3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

2.5 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in ODs or of different materials. Include end connections of same size as and compatible with pipes to be joined.

2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

3. Shielded, Nonpressure Transition Couplings:
   a. Standard: ASTM C1460.
   b. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
   c. End Connections: Same size as and compatible with pipes to be joined.

4. Pressure Transition Couplings:
   a. Standard: AWWA C219.
   b. Description: Metal sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
   c. Center-Sleeve Material: Manufacturer's standard.
   d. Gasket Material: Natural or synthetic rubber.
   e. Metal Component Finish: Corrosion-resistant coating or material.

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.2 INSTALLATION OF PIPING

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.

   1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
   2. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment".

K. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.

1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.
2. Use long-turn, double Y-branch, and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.

    a. Straight tees, elbows, and crosses may be used on vent lines.

3. Do not change direction of flow more than 90 degrees.
4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.

    a. Reducing size of waste piping in direction of flow is prohibited.

L. Lay buried building waste piping beginning at low point of each system.

1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
3. Maintain swab in piping and pull past each joint as completed.

M. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:

1. Building Sanitary Waste: Two percent downward in direction of flow for piping NPS 3 and smaller; 2 percent downward in direction of flow for piping NPS 4 and larger.
2. Horizontal Sanitary Waste Piping: Two percent downward in direction of flow.
3. Vent Piping: One percent down toward vertical fixture vent or toward vent stack.

N. Install cast-iron soil piping in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

1. Install encasement on underground piping in accordance with ASTM A674 or AWWA C105/A 21.5.

O. Install steel piping in accordance with applicable plumbing code.

P. Install aboveground PVC piping in accordance with ASTM D2665.

Q. Install underground PVC piping in accordance with ASTM D2321.

R. Install engineered soil and waste and vent piping systems as follows:

1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
2. Hubless, Single-Stack Drainage System: Comply with ASME B16.45 and hubless, single-stack aerator fitting manufacturer's written installation instructions.

3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.

S. Install underground, ductile-iron, force-main piping according to AWWA C600.

1. Install buried piping inside building between wall and floor penetrations and connection to sanitary sewer piping outside building with restrained joints.
2. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.
3. Install encasement on piping in accordance with ASTM A674 or AWWA C105/A 21.5.

T. Install underground, copper, force-main tubing in accordance with CDA's "Copper Tube Handbook."

1. Install encasement on piping in accordance with ASTM A674 or AWWA C105/A 21.5.

U. Plumbing Specialties:

1. Install backwater valves in sanitary waster gravity-flow piping.

   a. Comply with requirements for backwater valves specified in Section 221319 "Sanitary Waste Piping Specialties."

2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.

   a. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping.
   b. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."

3. Install drains in sanitary waste gravity-flow piping.

   a. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."

V. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

W. Install sleeves for piping penetrations of walls, ceilings, and floors.

1. Comply with requirements for sleeves specified in Section 220500 "Common Work Results for Plumbing."

X. Install sleeve seals for piping penetrations of concrete walls and slabs.

1. Comply with requirements for sleeve seals specified in Section 220500 "Common Work Results for Plumbing."

Y. Install escutcheons for piping penetrations of walls, ceilings, and floors.

1. Comply with requirements for escutcheons specified in Section 220500 "Common Work Results for Plumbing."

3.3 JOINT CONSTRUCTION

A. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

B. Hub-and-Spigot, Cast-Iron Soil Piping Caulked Joints: Join in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum caulked joints.

C. Hubless, Cast-Iron Soil Piping Coupled Joints:

1. Join hubless, cast-iron soil piping in accordance with CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

D. Join copper tube and fittings with soldered joints in accordance with ASTM B828. Use ASTM B813, water-flushable, lead-free flux and ASTM B32, lead-free-alloy solder.

E. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings in accordance with the following:

1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.
2. ABS Piping: Join in accordance with ASTM D2235 and ASTM D2661 appendixes.
3. PVC Piping: Join in accordance with ASTM D2855 and ASTM D2665 appendixes.

3.4 INSTALLATION OF SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in ODs.
2. In Waste Drainage Piping: Shielded, nonpressure transition couplings.
3. In Aboveground Force Main Piping: Fitting-type transition couplings.
4. In Underground Force Main Piping:

a. NPS 1-1/2 (DN 40) and Smaller: Fitting-type transition couplings.
b. NPS 2 (DN 50) and Larger: Pressure transition couplings.

3.5 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment".

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install stainless steel pipe hangers for horizontal piping in corrosive environments.
3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
4. Install stainless steel pipe support clamps for vertical piping in corrosive environments.
5. Vertical Piping: MSS Type 8 or Type 42 clamps.
6. Install individual, straight, horizontal piping runs:

a. 100 Ft. (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
b. Longer Than 100 Ft. (30 m): MSS Type 43, adjustable roller hangers.

c. Longer Than 100 Ft. (30 m) if Indicated: MSS Type 49, spring cushion rolls.

7. Multiple, Straight, Horizontal Piping Runs 100 Ft. (30 m) or Longer: MSS Type 44 pipe rolls. Support pipe rolls on trapeze.
8. Base of Vertical Piping: MSS Type 52 spring hangers.

C. Install hangers for cast-iron soil piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

D. Install hangers for PVC piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

E. Support horizontal piping and tubing within 12 inches of each fitting and coupling.

F. Support vertical runs of cast-iron soil piping to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

G. Support vertical runs of PVC piping to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect waste and vent piping to the following:

1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
5. Install horizontal backwater valves with cleanout cover flush with floor.
6. Comply with requirements for backwater valves cleanouts and drains specified in Section 221319 "Sanitary Waste Piping Specialties."
7. Equipment: Connect waste piping as indicated.

    a. Provide shutoff valve if indicated and union for each connection.
    b. Use flanges instead of unions for connections NPS 2-1/2 and larger.

D. Connect force-main piping to the following:

1. Sanitary Sewer: To exterior force main.
2. Sewage Pump: To sewage pump discharge.

E. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

F. Make connections in accordance with the following unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.7 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping.

B. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.8 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary waste and vent piping in accordance with procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.

    a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.

2. Leave uncovered and unconcealed new, altered, extended, or replaced waste and vent piping until it has been tested and approved.

    a. Expose work that was covered or concealed before it was tested.

3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.

    a. Close openings in piping system and fill with water to point of overflow, but not less than 10 ft. head of water.
    b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
    c. Inspect joints for leaks.

4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight.

    a. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1 inch wg.
    b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.
    c. Air pressure must remain constant without introducing additional air throughout period of inspection.
    d. Inspect plumbing fixture connections for gas and water leaks.

5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

E. Test force-main piping in accordance with procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved.

    a. Expose work that was covered or concealed before it was tested.

2. Cap and subject piping to static-water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials.

    a. Isolate test source and allow to stand for four hours.
    b. Leaks and loss in test pressure constitute defects that must be repaired.

3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
4. Prepare reports for tests and required corrective action.

3.9 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

D. Exposed Plastic Piping: Protect PVC plumbing vents exposed to sunlight with two coats of water-based latex paint.

E. Repair damage to adjacent materials caused by waste and vent piping installation.

3.10 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground, soil and waste piping NPS 4 (DN 100) and smaller are to be the following:

1. Service cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

C. Aboveground, soil and waste piping NPS 5 (DN 125) and larger are to be the following:
1. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.
2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

D. Aboveground, vent piping NPS 4 (DN 100) is to be the following:
1. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
2. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.

E. Aboveground, vent piping NPS 5 (DN 125) and larger is to be the following:
1. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
2. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.

F. Underground, soil, waste, and vent piping NPS 4 (DN 100) and smaller are to be the following:
1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

G. Underground, soil and waste piping NPS 5 (DN 125) and larger are to be the following:
1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

END OF SECTION 22 1316

SECTION 22 1319

SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Backwater valves.
2. Cleanouts.
3. Air-admittance valves.
4. Miscellaneous sanitary drainage piping specialties.

B. Related Requirements:

1. Section 076200 "Sheet Metal Flashing and Trim" for metal roof flashing assemblies.
2. Section 077200 "Roof Accessories" for preformed flashings.
3. Section 078413 "Penetration Firestopping" for through-penetration firestop assemblies.
4. Section 221323 "Sanitary Waste Interceptors" for metal and concrete interceptors outside the building, grease interceptors, grease-removal devices, oil interceptors, and solids interceptors.
5. Section 221423 "Storm Drainage Piping Specialties" for trench drains for storm water, channel drainage systems for storm water, roof drains, and catch basins.
6. Section 224300 "Healthcare Plumbing Fixtures" for plaster sink interceptors.
7. Section 334200 "Stormwater Conveyance" for storm drainage piping and piping specialties outside the building.

1.3 DEFINITIONS

A. ABS: Acrylonitrile butadiene styrene.

B. PVC: Polyvinyl chloride.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Show fabrication and installation details for frost-resistant vent terminals.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For sanitary waste piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTIONS

A. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14 for plastic sanitary waste piping specialty components.

2.2 BACKWATER VALVES

A. Horizontal, Cast-Iron Backwater Valves <**Insert drawing designation, if any**>:
   1. Manufacturer:
      a. Zurn Industries, LLC.: Z1090
   2. Standard: ASME A112.14.1.
   3. Size: Same as connected piping.
   4. Body: Dura-coated cast iron.
   5. Cover: Cast iron with bolted access check valve.
   6. End Connections: Hubless.
   7. Type Check Valve: Removable, bronze, swing check, factory assembled or field modified to hang open for airflow unless subject to backflow condition.
   8. Extension: ASTM A74, Service Class; full-size, cast-iron, soil-pipe extension to field-installed cleanout at floor; replaces backwater valve cover.

2.3 CLEANOUTS

A. Cast-Iron Exposed Cleanouts:
   1. Manufacturer:
      a. Sioux Chief Manufacturing Company, Inc., Model #834 “Finish Line” adjustable cleanout, no exceptions.
   2. Standard: ASME A112.36.2M.
   3. Size: Same as connected drainage piping
   4. Body Material: Hubless, cast-iron soil pipe T-branch as required to match connected piping.
   5. Closure: Countersunk, brass plug.
   6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
   7. Cleanouts shall have square tops with nickel bronze finish – No Exceptions.

2.4 Floor Drain - Cast Iron:

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
   1. Sioux Chief Manufacturing Company, Inc.
      a. Source Limitations: Obtain cast-iron floor drains from single manufacturer. Model #833.
   2. Standard: ASME A112.6.3.
   3. Pattern: Floor and Funnel floor drain.
   4. Body Material: Ductile iron.
   5. Top or Strainer Material: Nickel bronze.
   6. Top of Body and Strainer Finish: Nickel bronze.
   7. Top Shape: Square.

2.5 Floor Drain - Plastic:

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
   1. Sioux Chief Manufacturing Company, Inc.
      a. Source Limitations: Obtain cast-iron floor drains from single manufacturer. Model #833.
   2. Pattern: Floor and Funnel floor drain.
   3. Body Material: PVC.
   4. Top or Strainer Material: Nickel bronze.
   5. Top of Body and Strainer Finish: Nickel bronze.
   6. Top Shape: Square.

B. Floor Sink - Cast Iron:

   1. Manufacturers: Subject to compliance with requirements, provide products by the following:

      a. Josam: Model 49340A Series
      b. Sioux Chief Manufacturing Company, Inc.: Model 861-2x series
      c. or approved equal

   2. Standard: ASME A112.6.3.
   3. Pattern: Floor drain.
   4. Body Material: Cast iron with acid resistant porcelain enameled coated interior.
   5. Outlet: Bottom, no-hub connection.
   6. Internal Strainer: Dome.
   7. Internal Strainer Material: Aluminum.
   8. Top Grate Material: 12.x12, nickel-bronze anti-tilting half grate unless noted otherwise on plan.

2.6 HAIR TRAP/INTERCEPTOR

A. Hair Trap:

   1. Manufacturers: Subject to compliance with requirements, provide products by the following:

      a. Zurn: Hair Interceptor Model Z1175

b. J.R. Smith: Hair Interceptor Model 8750-CP
c. Or approved equal.

2. Dura-coated cast iron hair and solids interceptor, in lieu of fixture 'P' trap, with 1-1/2 slip joint elbox intoet and 1-1/2 threaded side outlet, perforated stainless steel basket removable from bottom, with flanged and gasketed cleanout cov er with raised hex head. Perforation size is 1/8-inch.
3. Finish: Chrome plated finish interior and exterior.
4. Location: Below shampoo bowls in Salon/Spa.
5. Furnished and installed by plumbing contractor.

2.7 INTERIOR TRENCH DRAINS

A. See drawings for the pool trench drain system and requirements. The plumbing contractor is responsible for the pool trench drain system.

B. Interior Pool Trench Drains
1. Manufacturers:
a. Zurn Industries, LLC.: Model Z888-4-PVSS-BG. No exceptions.
2. Grate and Fram: Heavy-duty stainless-steel frame.
3. Body Material: High density polyethylene.
4. Outlet: End.
5. Fittings: Manufactured only.
6. Provide Sioux Chief 875-4A cleanout bushing with 852-4PNQ adjustable cover with nickel bronze square top. Refer to detail on drawings.

C. Shower Area Trench Drains:
1. Manufacturers:
a. Zurn ZS880. No exceptions.
2. Grate: Tile in-lay grate
3. Body material: Stainless steel
4. Outlet: Bottom.

D. Whirlpool Suite Trench Drains:
1. Manufacturer:
a. Zurn ZS880. No exceptions.
2. Grate: Tile in-lay grate.
3. Body Material: Stainless steel.
4. Outlet: Bottom.

2.8 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Deep-Seal Traps:

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.

a. NPS 2: 4-inch-minimum water seal.
b. NPS 2-1/2 and Larger: 5-inch-minimum water seal.

B. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 1 inch above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

C. Stack Flashing Fittings:

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

D. Vent Caps:

1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
2. Size: Same as connected stack vent or vent stack.

E. Frost-Resistant Vent Terminals:

1. Description: Manufactured or shop-fabricated assembly constructed of copper, lead-coated copper, or galvanized steel.
2. Design: To provide 1-inch enclosed air space between outside of pipe and inside of flashing collar extension, with counterflashing.

F. Expansion Joints:

1. Standard: ASME A112.6.4.
2. Body: Cast iron with bronze sleeve, packing, and gland.
3. End Connections: Matching connected piping.
4. Size: Same as connected soil, waste, or vent piping.

2.9 GREASE INTERCEPTORS

A. Grease Interceptors:
1. Manufacturer:
   a. Schier Great Basin Series (model on drawings), exterior.
2. Serves: Café and Bistro
3. Description: Schier Great Basin grease interceptor shall be lifetime guaranteed and made in USA of seamless, rotationally-molded High-density polyethylene with minimum 3/8” uniform wall thickness. Interceptor shall be furnished for above or below grade installation. Interceptor shall be built in accordance with ASME A112.14.3 (type C) and CSA B481.1, with field adjustable riser system, built-in flow control, built int test caps and three outlet options.
4. Cover: Heavy vehicle traffic, cast iron, manhole covers.
5. Manhole cover: Bolt or locking with airtight gasket seal.
6. Nameplate: Permanent 4”x6” label with the words “grease interceptor”.
7. Interceptors must meet the local codes and City/County ordinances.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install backwater valves in building drain piping.

1. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.

B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate at base of each vertical soil and waste stack.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Install fixture air-admittance valves on fixture drain piping.

F. Install stack air-admittance valves at top of stack vent and vent stack piping.

G. Install air-admittance-valve wall boxes recessed in wall.

H. Assemble open drain fittings and install with top of hub 1 inch above floor.

I. Install deep-seal traps on floor drains and other waste outlets, if indicated.

J. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.

1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
2. Size: Same as floor drain inlet.

K. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

L. Install sleeve and sleeve seals with each riser and stack passing through floors with waterproof membrane.

M. Install vent caps on each vent pipe passing through roof.

N. Install frost-resistant vent terminals on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.

O. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.

P. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.

Q. Install wood-blocking reinforcement for wall-mounting-type specialties.

R. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 PIPING CONNECTIONS

A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment, to allow service and maintenance.

3.3 LABELING AND IDENTIFYING

A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit.

1. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 22 1319

SECTION 22 1414

STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Hub-and-spigot, cast-iron soil pipe and fittings.
2. Hubless, cast-iron soil pipe and fittings.
3. PVC pipe and fittings.
4. Specialty pipe fittings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For controlled-flow roof drainage system. Include calculations, plans, sections, elevations, and details.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans and elevations or Building Information Model (BIM) drawn to scale, showing items described in this Section and coordinated with all building trades.

B. Seismic Qualification Certificates: For storm drainage piping, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Detailed description of piping anchorage devices on which the certificate is based and their installation requirements.

C. Field Quality-Control Reports: Inspection reports signed by authorities having jurisdiction.

1.4 QUALITY ASSURANCE

A. Provide materials bearing label, stamp, or other markings of specified testing agency.

1.5 FIELD CONDITIONS

A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Construction Manager no fewer than two days in advance of proposed interruption of storm drainage service.
2. Do not proceed with interruption of storm drainage service without Construction Manager's written permission.

1.6 WARRANTY

A. Listed manufacturers to provide labeling and warranty of their respective products

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Components and installation are to be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Storm Drainage Piping: 10-foot head of water.
2. Storm Drainage, Force-Main Piping: 50 psig.

2.2 PIPING MATERIALS

A. Piping materials to bear label, stamp, or other markings of specified testing agency.

B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings:

1. Marked with CISPI collective trademark and NSF certification mark.
2. Standard: ASTM A74.
3. Class: Service weight cast iron.

B. Gaskets: ASTM C564, rubber.

C. Caulking Materials: ASTM B29, pure lead and oakum or hemp fiber.

2.4 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings:

1. Marked with CISPI collective trademark and NSF certification mark.
2. Standards: ASTM A888 and CISPI 301.

B. Standard, Hubless-Piping Couplings:
1. Marked with CISPI collective trademark.
2. Standards: ASTM C1277 and CISPI 310.

3. Description: Stainless steel corrugated shield with stainless steel bands and tightening devices; and ASTM C564, rubber sleeve with integral, center pipe stop.

C. Heavy-Duty, Hubless-Piping Couplings:
1. Standard: ASTM C1277 or ASTM C1540.
2. Description: Stainless steel shield with stainless steel bands and tightening devices; and ASTM C564, rubber sleeve with integral, center pipe stop.

2.5 PVC PIPE AND FITTINGS

A. PVC Pipe:
1. NSF Marking: Comply with NSF 14 for plastic piping components. Include marking with "NSF-dwv" for plastic storm drain and "NSF-sewer" for plastic storm sewer piping.
2. Solid-Wall PVC Pipe: ASTM D2665 drain, waste, and vent.

B. PVC Socket Fittings:
1. Standard: ASTM D2665, made in accordance with ASTM D3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
2. NSF Marking: Comply with NSF 14 for plastic piping components. Include marking with "NSF-dwv" for plastic storm drain and "NSF-sewer" for plastic storm sewer piping.

2.6 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in ODs or of different materials. Include end connections of same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified-piping-system fitting.
3. Unshielded, Nonpressure Transition Couplings:
   a. Standard: ASTM C1173.
   b. Description: Elastomeric sleeve, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
   c. Sleeve Materials:

      1) For Cast-Iron Soil Pipes: ASTM C564 rubber.
      2) For Plastic Pipes: ASTM F477, elastomeric seal or ASTM D5926 PVC.
      3) For Dissimilar Pipes: ASTM D5926 PVC or other material compatible with pipe materials being joined.

4. Shielded, Nonpressure Transition Couplings:
   a. Standard: ASTM C1460.
   b. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
   c. End Connections: Same size as and compatible with pipes to be joined.
   d. Metal Component Finish: Corrosion-resistant coating or material.

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.2 INSTALLATION OF PIPING

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.

B. Install piping as indicated unless deviations from layout are approved on coordination drawings.

C. Install piping in concealed locations.

1. Piping installed in equipment rooms, service areas, and where indicated may be exposed.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

L. Make changes in direction for piping using appropriate branches, bends, and long-sweep bends.

1. Do not change direction of flow more than 90 degrees.
2. Use proper size of standard increasers and reducers if pipes of different sizes are connected.

a. Reducing size of drainage piping in direction of flow is prohibited.

M. Lay buried building piping beginning at low point of each system.

1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

3. Maintain swab in piping and pull past each joint as completed.

N. Install piping at the following minimum slopes unless otherwise indicated.

1. Building Storm Drain: 1/4 inch per foot downward in direction of flow for piping NPS 3 and smaller; 1/8 inch per foot downward in direction of flow for piping NPS 4 and larger.
2. Horizontal Storm Drainage Piping: 1/4 inch per foot downward in direction of flow.

O. Install cast-iron soil piping in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Ch IV, "Installation of Cast Iron Soil Pipe and Fittings."

1. Install encasement on underground piping in accordance with ASTM A674 or AWWA C105/A 21.5.

P. Install steel piping in accordance with applicable plumbing code.

Q. Install engineered controlled-flow drain specialties and storm drainage piping in locations indicated.

1. Install encasement on piping in accordance with ASTM A674 or AWWA C105/A 21.5.

R. Install force mains at elevations indicated.

S. Plumbing Specialties:

1. Install backwater valves in storm drainage gravity-flow piping.

a. Comply with requirements for backwater valves specified in Section 221423 "Storm Drainage Piping Specialties."

2. Install cleanouts in storm drainage gravity-flow piping in accessible locations.

a. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping.
b. Comply with requirements for cleanouts specified in Section 221423 "Storm Drainage Piping Specialties."

3. Install drains in storm drainage gravity-flow piping.

a. Comply with requirements for drains specified in Section 221423 "Storm Drainage Piping Specialties."

T. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

U. Install sleeves for piping penetrations of walls, ceilings, and floors.

1. Comply with requirements for sleeves specified in Section 220500 "Common Work Results for Plumbing."

V. Install sleeve seals for piping penetrations of concrete walls and slabs.

1. Comply with requirements for sleeve seals specified in Section 220500 "Common Work Results for Plumbing."

W. Install escutcheons for piping penetrations of walls, ceilings, and floors.

1. Comply with requirements for escutcheons specified in Section 220500 "Common Work Results for Plumbing."

3.3 JOINT CONSTRUCTION

A. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

B. Hub-and-Spigot, Cast-Iron Soil Piping Caulked Joints: Join in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum caulked joints.

C. Hubless, Cast-Iron Soil Piping Coupled Joints: Join in accordance with CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

D. Threaded Joints: Thread pipe with tapered pipe threads in accordance with ASME B1.20.1.

1. Cut threads full and clean using sharp dies.
2. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

    a. Apply appropriate tape or thread compound to external pipe threads unless dry-seal threading is specified.
    b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
    c. Do not use pipe sections that have cracked or open welds.

E. Join copper tube and fittings with soldered joints in accordance with ASTM B828. Use ASTM B813, water-flushable, lead-free flux and ASTM B32, lead-free-alloy solder.

F. Joint Restraints and Sway Bracing:

1. Provide joint restraints and sway bracing for storm drainage piping joints to comply with the following conditions:

    a. Provide axial restraint for pipe and fittings 5 inches and larger, upstream and downstream of all changes in direction, branches, and changes in diameter greater than two pipe sizes.
    b. Provide rigid sway bracing for pipe and fittings 4 inches and larger, upstream and downstream of all changes in direction 45 degrees and greater.
    c. Provide rigid sway bracing for pipe and fittings 5 inches and larger, upstream and downstream of all changes in direction and branch openings.

3.4 INSTALLATION OF SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in ODs.
2. In Drainage Piping: Shielded, nonpressure transition couplings.
3. In Aboveground Force-Main Piping: Fitting-type transition couplings.

3.5 INSTALLATION OF VALVES

A. General valve installation requirements for general-duty valve installations are specified in Section 220523 "General-Duty Valves for Plumbing Piping."

B. Backwater Valves: Install backwater valves in piping subject to backflow.

1. Horizontal Piping: Horizontal backwater valves.
2. Install backwater valves in accessible locations.
3. Comply with requirements for backwater valves specified in Section 221423 "Storm Drainage Piping Specialties."

3.6 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for hangers, supports, and anchor devices specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install stainless steel pipe hangers for horizontal piping in corrosive environments.
3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
4. Install stainless steel pipe support clamps for vertical piping in corrosive environments.
5. Vertical Piping: MSS Type 8 or Type 42, clamps.
6. Install individual, straight, horizontal piping runs:

    a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet (30 m) if Indicated: MSS Type 49, spring cushion rolls.

7. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
8. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Install hangers for cast-iron galvanized-steel and copper soil tubing and piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

D. Support horizontal piping and tubing within 12 inches of each fitting[**, valve,**] and coupling.

E. Support vertical cast-iron to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent, but as a minimum at base and at each floor.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.

C. Connect storm drainage piping to roof drains and storm drainage specialties.

1. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
2. Install horizontal backwater valves with cleanout cover flush with floor.
3. Comply with requirements for backwater valves cleanouts and drains specified in Section 221423 "Storm Drainage Piping Specialties."

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

E. Make connections in accordance with the following unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.8 IDENTIFICATION

A. Identify exposed storm drainage piping.

B. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.9 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test storm drainage piping in accordance with procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.

    a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.

2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved.

    a. Expose work that was covered or concealed before it was tested.

3. Test Procedure:

a. Test storm drainage piping on completion of roughing-in.
b. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water.
c. From 15 minutes before inspection starts until completion of inspection, water level must not drop.
d. Inspect joints for leaks.

4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
5. Prepare reports for tests and required corrective action.

E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved.

a. Expose work that was covered or concealed before it was tested.

2. Cap and subject piping to static-water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials.

a. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.

3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
4. Prepare reports for tests and required corrective action.

3.10 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

3.11 PROTECTION

A. Protect piping and drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

B. Place plugs in ends of uncompleted piping at end of day and when work stops.

C. Repair damage to adjacent materials caused by storm drainage piping installation.

3.12 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground storm drainage piping NPS 6 and smaller is to be the following:
1. Hubless, cast-iron soil pipe and fittings; CISPI, hubless-piping couplings; and coupled joints.

C. Aboveground, storm drainage piping NPS 8 and larger is to be[**any of**] the following:

1. Hubless, cast-iron soil pipe and fittings; CISPI, hubless-piping couplings; and coupled joints.

D. Underground storm drainage piping NPS 6 and smaller shall be[**any of**] the following:
   1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

E. Underground, storm drainage piping NPS 8 and larger is to be the following:
   1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

END OF SECTION 22 1414

SECTION 22 1423

STORM DRAINAGE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. General-purpose roof drains.
2. Pool trench drains
3. Pool deck roof drains
4. Miscellaneous storm drainage piping specialties.
5. Cleanouts.
6. Backwater valves.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 GENERAL-PURPOSE ROOF DRAINS

A. Roof Drains, General Purpose - Cast Iron:

1. Roof Drain, General Purpose - Cast Iron, Large Sump:

a. Manufacturers: Subject to compliance with requirements, provide products by the following:

1) Jay R. Smith Mfg Co; a division of Morris Group International
2) Josam Company
3) Wade; a subsidiary of McWane Inc.
4) Zurn Industries, LLC

b. Source Limitations: Obtain cast-iron roof drains from single manufacturer.
c. Standard: ASME A112.6.4.
d. Body Material: Cast iron.
e. Dimension of Body: Nominal 15-inch diameter.
f. Dome Material: Cast iron.
g. Combination flashing ring and gravel stop.
h. Outlet: Bottom.
i. Outlet Type: No-hub.
j. Options:

1) Underdeck clamp.

2.2 POOL DECK ROOF DRAINS

A. See drawings for the pool deck area drains and requirements. The plumbing contractor is responsible for pool drainage system.

B. Exterior Area Drains (in pavers) AD-2:

a. Manufacturers: Subject to compliance with requirements, provide products by the following:

1) Zurn Industries, LLC

a) Model Z158-ZN-10” square top pom-deck drain with heel proof grate and rotatable frame.

b. Source Limitations: Obtain cast-iron, medium-sump, deck roof drains from single manufacturer.
c. Body Material: Cast iron.

C. Exterior Area Drains (in perimeter landscaping) AD-3:

a. Manufacturers: Subject to compliance with requirements, provide products by the following:

1) Zurn Industries, LLC

a) Model Z125 Dura-coated cast iron dome planting area drain with flashing clamp, self-locking dome and stainless steel mesh.

b. Source Limitations: Obtain cast-iron, medium-sump, deck roof drains from single manufacturer.
c. Body Material: Cast iron.
d. Grate and Frame Material: Epoxy coated cast iron.
e. Screen: Stainless steel mesh.

2.3 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

A. Downspout Nozzle - Metal:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Jay R. Smith Mfg Co; a division of Morris Group International
b. Josam
c. Wade; a subsidiary of McWane Inc.
d. Zurn Industries, LLC

2. Source Limitations: Obtain metal downspout nozzles from single manufacturer.
3. Description: Bronze body with threaded inlet and bronze wall flange with mounting holes.
4. Size: Same as connected downspout.

2.4 CLEANOUTS

A. Cast-Iron Cleanouts:

1. Cleanout, Exposed Type - Cast Iron:

    a. Manufacturers: Subject to compliance with requirements, provide products by the following:

        1) Sioux Chief Manufacturing Company, Inc., Model #834 “finish line” adjustable cleanout, no exceptions.

    b. Source Limitations: Obtain cast-iron exposed cleanouts from single manufacturer.
    c. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
    d. Size: Same as connected branch.
    e. Body Material: No-hub, cast-iron soil pipe test tee as required to match connected piping.
    f. Closure: Countersunk, brass plug.
    g. Closure Plug Size: Same as, or not more than, one size smaller than cleanout size.

2. Test Tee - Cast Iron:

    a. Standard: ASME A112.36.2M and ASTM A74, ASTM A888, or CISPI 301.
    b. Size: Same as connected drainage piping.
    c. Body Material: Hub-and-spigot, cast-iron soil-pipe T-branch or no-hub, cast-iron soil-pipe test tee as required to match connected piping.
    d. Closure Plug: Countersunk, brass.
    e. Closure Plug Size: Same as, or not more than, one size smaller than cleanout size.

B. Wall Cleanouts:

    a. Source Limitations: Obtain plastic cleanouts from single manufacturer.
    b. Size: Same as connected branch.
    c. Body Material: As required to match connected piping.
    d. Closure: Countersunk, drilled and threaded brass plug.
    e. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
    f. Wall Access: Square, stainless-steel wall-installation frame and cover

2.5 BACKWATER VALVES

1. Backwater Valve:

    a. Manufacturers: Subject to compliance with requirements, provide products by the following:

        1) Zurn Industries, LLC

            a) Model Z1090

    b. Source Limitations: Obtain cast-iron, drain-outlet backwater valves from single manufacturer.
    c. Size: Same as floor drain outlet.
    d. Body Material: Dura-coated cast iron with gasketed bolted cover.
    e. Flapper: Automatic PVC with O-ring.
    f. Inlet: no-hub.
    g. Outlet: no-hub.

2.6 POOL TRENCH DRAINS

A. See drawings for the pool trench drain system and requirements. The plumbing contractor shall be responsible for pool trench drain system.

B. Pool Trench Drains (TD-1):

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Zurn Industries, LLC

1) Model Z888-4-PVSS-BG. No exceptions.

2. Source Limitations: Obtain trench drains from single manufacturer.
3. Standard: ASME A112.6.3.
4. Body Material: High density polyethylene.
5. Top-Loading Classification: Heavy Duty.
6. Grate and Frame Material: Heavy duty “HD” stainless steel frame.
7. Outlet: End.
8. Fittings: manufactured only.

C. Exterior Pickleball Trench Drains (TD-4):

1. Manufacturers: Zurn Industries, LLC

a. Model Z886-E6-HPP-VP. No exceptions

2. Grate and Frame: heavy Duty “HD” Stainless steel frame.
3. Body Material: high density polyethylene.
4. Outlet End.
5. Fittings: Manufactured only.

PART 3 - EXECUTION

3.1 INSTALLATION OF GENERAL-PURPOSE ROOF DRAINS

A. Install general-purpose roof drains in accordance with roof membrane manufacturer's written installation instructions at low points of roof areas.

1. Install flashing collar or flange of roof drain to maintain integrity of waterproof membranes where penetrated.
2. Install expansion joints, if indicated, in roof drain outlets.
3. Position roof drains for easy access and maintenance.

B. Fabricate flashing from single piece of metal unless large pans, sumps, or other drainage shapes are required.

C. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

D. Set flashing on roofs in solid coating of bituminous cement.

E. Secure flashing into sleeve and specialty clamping ring or device.

F. Install through-penetration firestop assemblies for penetrations of fire- and smoke-rated assemblies.

1. Comply with requirements in Section 078413 "Penetration Firestopping."

3.2 INSTALLATION OF DECK ROOF DRAINS

A. Install deck roof drains in accordance with roof membrane manufacturer's written installation instructions at low points of roof areas.

1. Install flashing collar or flange of roof drain to maintain integrity of waterproof membranes where penetrated.
2. Install expansion joints, if indicated, in roof drain outlets.
3. Position roof drains for easy access and maintenance.

B. Fabricate flashing from single piece of metal unless large pans, sumps, or other drainage shapes are required.

C. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

D. Set flashing on roofs in solid coating of bituminous cement.

E. Secure flashing into sleeve and specialty clamping ring or device.

F. Install through-penetration firestop assemblies for penetrations of fire- and smoke-rated assemblies.

1. Comply with requirements in Section 078413 "Penetration Firestopping."

3.3 INSTALLATION OF MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

A. Install downspout adapters on outlet of back-outlet parapet roof drains and connect to sheet metal downspouts.

B. Install downspout nozzles at exposed bottom of conductors where they spill onto grade.

3.4 INSTALLATION OF CLEANOUTS

A. Install cleanouts in aboveground piping and building drain piping in accordance with the following instructions unless otherwise indicated:

1. Use cleanouts the same size as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate cleanouts at each change in direction of piping greater than 45 degrees.
3. Locate cleanouts at minimum intervals of 50 ft. for piping NPS 4 and smaller and 100 ft. for larger piping.
4. Locate cleanouts at base of each vertical storm piping conductor.

B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with

finished floor.

C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

D. Install wall cleanouts in vertical conductors. Install access door in wall if indicated.

E. Install test tees in vertical conductors and near floor.

3.5 INSTALLATION OF BACKWATER VALVES

A. Install horizontal backwater valves in floor with cover flush with floor.

B. Install drain-outlet backwater valves in outlet of drains.

3.6 INSTALLATION OF TRENCH DRAINS

A. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface unless otherwise indicated.

B. Assemble channel drainage system components in accordance with manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.

3.7 INSTALLATION OF CONCRETE TRENCH DRAIN-FORMING SYSTEM

A. Install in accordance with manufacturer's written installation instructions.

3.8 PIPING CONNECTIONS

A. Comply with requirements for piping specified in Section 221414 "Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

3.9 CLEANING

A. Clean piping specialties of dirt and superfluous materials. Flush with potable water.

3.10 PROTECTION

A. Protect piping specialties during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic and construction work.

B. Place plugs in ends of uncompleted piping at end of each day and when work stops.

END OF SECTION 22 1423

SECTION 22 1429

SUMP PUMPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sump pumps - submersible.
2. Sump-pump basins and basin covers.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Sump pumps - submersible.
2. Sump-pump basins and basin covers.

B. Product Data Submittals: For each product.

1. Construction details, material descriptions, dimensions of individual components and profiles.
2. Rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

C. Shop Drawings:

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For pumps and controls.

1. Indicate actual installed items by marking submittals with an arrow or box.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Retain shipping flange protective covers and protective coatings during storage.

B. Protect bearings and couplings against damage.

C. Comply with manufacturer's written instructions for handling.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain each type of sump pump from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and use.

B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

2.3 SUMP PUMPS - SUBMERSIBLE

A. Sump Pumps - Submersible, Fixed Position, Single Seal: .
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Zoeller Company.
   2. Description: Factory-assembled and -tested sump-pump unit.
   3. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal sump pump as defined in HI 14.1-14.2 and HI 14.3.
   4. Pump Casing: Non-corrosive engineered plastic, with strainer inlet, legs that elevate pump to permit flow into impeller, and vertical discharge for piping connection.
   5. Impeller: Statically and dynamically balanced, plastic design for clear wastewater handling, and keyed and secured to shaft.
   6. Pump and Motor Shaft: Stainless steel, with factory-sealed, grease-lubricated ball bearings.
   7. Seal: Mechanical.
   8. Capability: Pass 3/8-inch solids.
   9. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.

   10. Controls, Rod-and-Float Type:

       a. Enclosure: NEMA 250, Type 1.
       b. Switch Type: Pedestal-mounted float switch with float rods and rod buttons.
       c. Float Guides: Pipe or other restraint for floats and rods in basins of depth greater than 60 inches.
       d. High-Water Alarm: Cover-mounted, compression-probe alarm, with electric bell; 120 V ac, with transformer and contacts for remote alarm bell.
       e. High-Water Alarm:
          1) Manufacturer: SJE Rhomus
          2) Model: TA AB-01H
          3) Voltage: 120 VAC, 60 Hz, 2.4 watts max.
          4) Secondary: 9VDC
          5) Battery Backup Power: 9VDC
          6) Alarm Enclosure: Nema 1 plastic.
          7) Float Switch Connection Terminal:
             a) Float Switch: SJE Signal Master control switch with mounting clamp.

b) Cable: 15 feet, flexible 18-gauge, 2 conductor SJOW, water resistance.

2.4 SUMP-PUMP BASINS AND BASIN COVERS

A. Basins: Factory-fabricated, watertight, cylindrical, basin sump with top flange and sidewall openings for pipe connections.

1. Material: Fiberglass.
2. Reinforcement: Mounting plates for pumps, fittings, and accessories.
3. Anchor Flange: Same material as or compatible with basin sump, cast in or attached to sump, and in location and of size required to anchor basin in concrete slab.

B. Basin Covers: Fabricate metal cover with openings having gaskets, seals, and bushings; for access to pumps, pump shafts, control rods, discharge piping, vent connections, and power cables.

1. Reinforcement: Steel or cast iron, capable of supporting foot traffic for basins installed in foot-traffic areas.

2.5 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 220500 "Common Work Results for Plumbing."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

B. Motors for submersible pumps are to be hermetically sealed.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation and filling are specified in Section 312000 "Earth Moving."

3.2 EXAMINATION

A. Examine roughing-in for plumbing piping to verify actual locations of storm drainage piping connections before sump-pump installation.

3.3 INSTALLATION

A. Pump Installation Standards: Comply with HI 14.4 for installation of sump pumps.

B. Equipment Mounting:

1. Comply with requirements for vibration isolation and seismic control devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
2. Comply with requirements for vibration isolation devices specified in Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment."

C. Wiring Method: Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

D. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.4 PIPING CONNECTIONS

A. Comply with requirements for piping specified in Section 221414 "Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to equipment, allow space for service and maintenance.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks in accordance with manufacturer's written instructions.

3.6 ADJUSTING

A. Adjust pumps to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust control set points.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test, inspect, and adjust components, assemblies, and equipment installations, including connections.

C. Tests and inspections:

1. Perform each visual and mechanical inspection.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
5. Pumps and controls will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain controls and pumps.

END OF SECTION 22 1429

SECTION 22 3100

DOMESTIC WATER SOFTENERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Water softeners.
2. Chemicals.
3. Water-testing sets.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for water softeners.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings:

1. Include diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Data: Certificates, for water softeners, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Source quality-control reports.

C. Field quality-control reports.

D. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For water softeners to include in emergency, operation, and maintenance manuals.

1.5 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of water softeners that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures of mineral and brine tanks.
b. Faulty operation of controls.
c. Deterioration of metals, metal finishes, and other materials beyond normal use.
d. Attrition loss of resin exceeding 3 percent per year.
e. Mineral washed out of system during service run or backwashing period.
f. Effluent turbidity is greater and darker than incoming water.
g. Fouling of underdrain system, gravel, and resin with turbidity or by dirt, rust, or scale from water softener or soft water, while operating according to manufacturer's written operating instructions.

2. Water Softeners, Warranty Period: From date of Substantial Completion.

a. Mineral Tanks: Five years.
b. Brine Tanks: 5 years.
c. Control Valve: 5 year(s).

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Drinking Water System Components - Health Effects and Drinking Water System Components - Lead Content Compliance: NSF 61 and NSF 372.

2.2 WATER SOFTENERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Water Control Corporation
2. Model: Progressive/metered water softening system. See plumbing drawings.

B. Description: Factory-assembled, pressure-type water softener.

1. Configuration: Triple unit with three mineral tanks and one brine tank.
2. Mounting: On skids.
3. Mineral Tanks, FRP: Pressure-vessel quality.

a. Construction: Fiberglass reinforced polyester, reinforced with continuous roving glass filament overwrap. Tanks shall have a molded polypropylene base for support. Non-ASME code.
b. Pressure Rating: 150 psig minimum.

c. Freeboard: 50 percent minimum for backwash expansion above normal resin bed level.
d. Support Legs or Skirt: Constructed of structural steel, welded to tank.
e. Upper Distribution System: Single, point type, fabricated from galvanized-steel pipe and fittings.
f. Lower Distribution System: Hub and radial-arm or header-lateral type; fabricated from nonmetallic pipe and fittings with individual, fine-slotted, nonclogging plastic strainers, and arranged for even flow distribution through resin bed.

4. Controls, Fully Automatic: 120 V; factory wired and factory mounted on unit.

a. Adjustable duration of various regeneration steps.
b. Push-button start and complete manual operation.
c. Electric time clock and switch for fully automatic operation, adjustable to initiate regeneration at any hour of day and any day of week or at fixed intervals.
d. Sequence of Operation: Multiport pilot-control valve automatically pressure-actuates main operating valve through steps of regeneration and return to service.
e. Pointer on pilot-control valve shall indicate cycle of operation.
f. Includes means of manual operation of pilot-control valve if power fails.

5. Main Operating Valves: Industrial, automatic, multiport, diaphragm type with the following features:

a. Slow opening and closing, nonslam operation.
b. Diaphragm guiding on full perimeter from fully open to fully closed.
c. Isolated, dissimilar metals within valve.
d. Self-adjusting, internal, automatic brine injector that draws brine and rinses at constant rate independent of pressure.
e. Valve for single mineral-tank unit with internal automatic bypass of raw water during regeneration.
f. Sampling cocks for soft water.
g. Special tools are not required for service.

6. Flow Control: Automatic, to control backwash and flush rates over wide variations in operating pressure; does not require field adjustments.

a. Meter Control: Each mineral tank is equipped with signal-register-head water meter that produces electrical signal indicating need for regeneration on reaching hand-set total in gallons. Signal will continue until reset.
b. Demand-Initiated Control:
1) Each mineral tank of multiple mineral-tank unit is equipped with automatic-reset-head water meter that electrically activates cycle controllers to automatically regenerate at preset total in gallons. Head automatically resets to preset total in gallons for next service run. Electrical lockout prevents simultaneous regeneration of more than one tank.

7. Brine Tank: Combination measuring and wet-salt storing system.

a. Tank and Cover Material: Fiberglass, 3/16 inch thick; or molded PE, 3/8 inch thick.
b. Brine Valve: Float operated and plastic fitted for automatic control of brine withdrawal and freshwater refill.
c. Size: Large enough for at least four regenerations at full salting.

8. Factory-Installed Accessories:

a. Piping, valves, tubing, and drains.
b. Sampling cocks.
c. Main-operating-valve position indicators.
d. Water meters.

C. Capacity and Characteristics:
1. Service: Cold and hot water.
2. Continuous Service Flow Rate: 136 gallons per minute continuous at a 15 psi drop.
3. Peak Service Flow Rate: 182 gallons per minute peak at a 25 psi drop.
4. Minimum Service Flow Rate: 96 GPM at 7 psi drop.
5. Water Consumption: 40,000 gal./day.>
6. Water Demand: 24 hours/day.
7. Number of Mineral Tanks: Four.
8. Mineral Quantity, Each Tank: 10 cu. ft..
9. Mineral Exchange Capacity: 4000 grains/cu. ft. per lb of salt.
10. Manifold Pipe Size: 1-1/2.
11. Backwash to Drain Pipe Size: 1-1/2.
12. Electrical Characteristics:
a. Volts: 120.
b. Phases: 1.
c. Hertz: 60.
13. Salt Capacity: 850 lb.

D. Additional Options:
1. Brine Reclaim: System shall include brine reclaim system components for the recovery/reuse of brine water.
a. Drain line and brine tank solenoid valves (VAC, 1ph) shall be electrically-actuated, pre-wired for connection to softener control valves, and built with chloride- resistant plastic or 316SS wetted components.
b. Control valves and solenoid valves shall be pre-programmed to achieve a minimum 25% brine water usage reduction, with complete emptying of brine tank during each regeneration cycle.
2. Pre-plumbed Manifold: System to include pre-plumbed piping manifold, with inlet, outlet, bypass, drain line outlet, and (if applicable) Brine Reclaim connections.
a. Manifold to include isolation valves and meters for each individual softener valve.
b. Manifold to include full-sized system bypass with bypass isolation valve.
c. Manifold to include temporary pipe supports, to be installed onsite. Temporary pipe supports will require onsite modifications per the actual site requirements. Permanent piping supports shall be supplied, and installed by the installing contractor, per local code requirements.
3. System skid: Softener tanks and pre-plumbed piping manifold to be mounted on, and secured to, heavy-duty, powder-coated steel skid base.
a. Installing contractor responsible for additional securing of softener tanks to wall via seismic strapping (per local code).
b. Brine tank location: On skid
4. Brine tank and Bulk Salt Storage System designed to receive bulk salt deliveries via pneumatic delivery system.
a. Tank and Cover Material: 3/8” thick molded (high density) polyethylene. Brine tank shall be sized as required for salt delivery approximately once a month.
b. Other Components: Internal brine collector, filter bag(cover), automatic air check, gasketed salt platform and grid assembly.

c. Service Tap Enclosure: Surface mount at location shown on plans, Full 316 stainless steel, 29” wide x 12” high x6” deep, with 2” female PVC fill connection internal and include a hinged cover and key-lock mechanism. Coordinate mounting in existing wall at reasonable height for ready access by delivery personnel. Field coordinate location of door and pipe route.
d. Fill Piping: 2”Stainless steel piping from wall outlet to the tank, any required elbows shall be a long sweep stainless steel (for reduced friction). PVC pipe and fittings will not be accepted.
e. Anchor piping to structure at 5’ intervals with metallic full circumference pipe trapeze anchors. Stainless, or Copper.
f. All elbows on the installation shall be electronically grounded.

2.3 CHEMICALS

A. Mineral: High-capacity, sulfonated-polystyrene, ion-exchange resin that is stable over entire pH range with good resistance to bead fracture from attrition or shock.

1. Exchange Capacity: 30,000 grains/cu. ft. of calcium carbonate of resin when regenerated with 15 lb of salt.

B. Salt for Brine Tanks: High-purity sodium chloride, free of dirt and foreign material. Rock and granulated forms are unacceptable.

1. Form: Processed, food-grade salt pellets.

2.4 WATER-TESTING SETS

A. Description: Manufacturer's standard water-hardness testing apparatus and chemicals with testing procedure instructions. Include metal container suitable for wall mounting.

2.5 SOURCE QUALITY CONTROL

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

B. ASME Compliance for Steel Tanks: Fabricate and label mineral tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, where indicated.

C. ASME Compliance for FRP Tanks: Fabricate and label mineral tanks to comply with ASME Boiler and Pressure Vessel Code: Section X, where indicated.

D. UL Compliance: Fabricate and label water softeners to comply with UL 979, "Water Treatment Appliances."

E. Hydrostatically test mineral tanks before shipment to a minimum of one and one-half times the pressure rating.

F. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 INSTALLATION OF WATER SOFTENERS

A. Equipment Mounting:

1. Install water softeners on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
2. Comply with requirements for vibration isolation and seismic-control devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
3. Comply with requirements for vibration isolation devices specified in Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment."

B. Install seismic restraints for tanks and floor-mounting accessories and anchor to building structure.

C. Install brine lines and fittings furnished by equipment manufacturer, but not specified to be factory installed.

D. Prepare mineral-tank distribution system and underbed for minerals and place specified mineral into mineral tanks.

E. Install water-testing sets mounted on wall, unless otherwise indicated, and near water softeners.

3.2 PIPING CONNECTIONS

A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to equipment, allow space for service and maintenance.

C. Install shutoff valves on raw-water inlet and soft-water outlet piping of each mineral tank.

1. Metal general-duty valves are specified in Section 220523 "General-Duty Valves for Plumbing Piping."
2. Plastic valves are specified in Section 221116 "Domestic Water Piping."
3. Exception for water softeners with factory-installed shutoff valves at locations indicated.

D. Install pressure gauges on raw-water inlet and soft-water outlet piping of each mineral tank. Pressure gauges are specified in Section 220500 "Common Work Results for Plumbing."

1. Exception for water softeners with factory-installed pressure gauges at locations indicated.
2. Exception for household water softeners.
3. Exception for water softeners in hot-water service.

E. Install valved bypass in water piping around water softeners.

1. Metal general-duty valves are specified in Section 220523 "General-Duty Valves for Plumbing Piping."
2. Plastic valves are specified in Section 221116 "Domestic Water Piping."
3. Water piping is specified in Section 221116 "Domestic Water Piping."

4. Exception for water softeners in hot-water service.

F. Install indirect wastes to spill into open drains or pit with drain.

3.3 ELECTRICAL CONNECTIONS

A. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.

3.4 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.5 FIELD QUALITY CONTROL

A. Testing Agency:

1. Owner will engage a qualified testing agency to perform tests and inspections.
2. Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections with the assistance of a factory-authorized service representative.

D. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Water softeners will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

B. Add water to brine tanks and fill with the following form of salt:

1. Water Softeners: Processed, plain salt pellets.

C. Sample water softener effluent after startup and at three consecutive seven-day intervals (total of four samples), and prepare certified test reports for required water performance characteristics. Comply with the following:

1. ASTM D859, "Test Method for Silica in Water."
2. ASTM D1067, "Test Methods for Acidity or Alkalinity of Water."
3. ASTM D1068, "Test Methods for Iron in Water."
4. ASTM D1126, "Test Method for Hardness in Water."
5. ASTM D1129, "Terminology Relating to Water."
6. ASTM D3370, "Practices for Sampling Water from Closed Conduits."

D. options.

3.7 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain domestic water softeners.

END OF SECTION 22 3100

SECTION 22 3400

FUEL-FIRED, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Commercial, gas-fired, high-efficiency, storage, domestic-water heaters.
   2. Domestic-water heater accessories.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Equipment room drawing or BIM model, drawn to scale, on which the items described in this Section are shown and coordinated with all building trades.

B. Product Certificates: For each type of commercial, gas-fired, domestic-water heater.

C. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.

D. Source quality-control reports.

E. Field quality-control reports.

F. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fuel-fired, domestic-water heaters to include in emergency, operation, and maintenance manuals.

1.5 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of fuel-fired, domestic-water heaters that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

    a. Structural failures including storage tank and supports.
    b. Faulty operation of controls.
    c. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Periods: From date of Substantial Completion.

    a. Commercial, Gas-Fired, Storage, Domestic-Water Heaters:

        1) Storage Tank: 10 years.
        2) Controls and Other Components: Two year(s).

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and use.

B. ASME Compliance:

1. Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
2. Where ASME-code construction is indicated, fabricate and label commercial, finned-tube, domestic-water heaters to comply with ASME Boiler and Pressure Vessel Code: Section IV.

C. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 and NSF 372.

2.2 COMMERCIAL, GAS-FIRED, STORAGE, DOMESTIC-WATER HEATERS

A. Commercial, Power-Burner, Gas-Fired, Storage, Domestic-Water Heaters:
1. Manufacturers:
    a. PVI Industries LLC – Condensing Gas Fired Water Heater
2. Source Limitations: Obtain domestic-water heaters from single source from single manufacturer.
3. Standard: ANSI Z21.10.3/CSA 4.3.
4. Storage-Tank Construction: ASME-code steel with 150-psig working-pressure rating.

    a. Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.

        1) NPS 2 (DN 50) and Smaller: Threaded ends in accordance with ASME B1.20.1.
        2) NPS 2-1/2 (DN 65) and Larger: Flanged ends in accordance with ASME B16.5 for steel and stainless steel flanges and in accordance with ASME B16.24 for copper and copper-alloy flanges.

b. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
c. Lining: AquaPLEX complying with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending lining into and through tank fittings and outlets.

5. Factory-Installed, Storage-Tank Appurtenances:
a. Drain Valve: Corrosion-resistant metal with hose-end connection.
b. Insulation: Comply with ASHRAE/IES 90.1. Surround entire storage tank except connections and controls.
c. Jacket: Steel with enameled finish.
d. Burner: Inward-fired burner, stainless steel.
e. Temperature Control: Adjustable thermostat.
f. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.
g. Combination Temperature-and-Pressure Relief Valves: ANSI Z21.22/CSA 4.4. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select one relief valve with sensing element that extends into storage tank.

6. Special Requirements: NSF 5 construction.

2.3 DOMESTIC-WATER HEATER ACCESSORIES

A. Domestic-Water Expansion Tanks:
1. Source Limitations: Obtain domestic-water heaters from single source from single manufacturer.
2. Description: Steel, pressure-rated tank constructed with welded joints and factory-installed, butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
3. Construction:

a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
b. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
c. Air-Charging Valve: Factory installed.

B. Drain Pans: Corrosion-resistant metal with raised edge. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than NPS 3/4 with ASME B1.20.1 pipe threads.

C. Comply with requirements for ball-, butterfly-, or gate-type shutoff valves specified in Section 220523 "General-Duty Valves for Plumbing Piping."

1. Comply with requirements for balancing valves specified in Section 221119 "Domestic Water Piping Specialties."

D. Gas Shutoff Valves: ANSI Z21.15/CSA 9.1, manually operated. Furnish for installation in piping.

E. Automatic Gas Valves: ANSI Z21.21/CSA 6.5, appliance, electrically operated, on-off automatic valve.

F. Combination Temperature-and-Pressure Relief Valves: Include relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select relief valves with sensing element that extends into storage tank.

1. Gas-Fired, Domestic-Water Heaters: ANSI Z21.22/CSA 4.4.
2. Oil-Fired, Domestic-Water Heaters: ASME rated and stamped.

G. Pressure Relief Valves: Include pressure setting less than working-pressure rating of domestic-water heater.

1. Gas-Fired, Domestic-Water Heaters: ANSI Z21.22/CSA 4.4.
2. Oil-Fired, Domestic-Water Heaters: ASME rated and stamped.

H. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4.

I. Domestic-Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting domestic-water heater and water.

2.4 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect assembled domestic-water heaters and storage tanks specified to be ASME-code construction, in accordance with ASME Boiler and Pressure Vessel Code.

B. Hydrostatically test commercial domestic-water heaters and storage tanks to minimum of one and one-half times pressure rating before shipment.

C. Domestic-water heaters will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 INSTALLATION OF DOMESTIC-WATER HEATER

A. Commercial, Domestic-Water Heater Mounting: Install commercial domestic-water heaters on concrete base. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."

1. Exception: Omit concrete bases for commercial domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
2. Maintain manufacturer's recommended clearances.
3. Arrange units so controls and devices that require servicing are accessible.
4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
7. Install anchor bolts to elevations required for proper attachment to supported equipment.

8. Anchor domestic-water heaters to substrate.

B. Install domestic-water heaters level and plumb, in accordance with layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 220523 "General-Duty Valves for Plumbing Piping."

C. Install gas-fired, domestic-water heaters in accordance with NFPA 54.

1. Install gas shutoff valves on gas supply piping to gas-fired, domestic-water heaters without shutoff valves.
2. Install gas pressure regulators on gas supplies to gas-fired, domestic-water heaters without gas pressure regulators if gas pressure regulators are required to reduce gas pressure at burner.
3. Install automatic gas valves on gas supplies to gas-fired, domestic-water heaters if required for operation of safety control.
4. Comply with requirements for gas shutoff valves, gas pressure regulators, and automatic gas valves specified in Section 231123 "Facility Natural-Gas Piping."

D. Install commercial domestic-water heaters with seismic-restraint devices. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" and Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment."

E. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend domestic-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

F. Install combination temperature-and-pressure relief valves in water piping for domestic-water heaters without storage. Extend domestic-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

G. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 221119 "Domestic Water Piping Specialties."

H. Install thermometer on outlet piping of domestic-water heaters. Comply with requirements for thermometers specified in Section 220500 "Common Work Results for Plumbing."

I. Assemble and install inlet and outlet piping manifold kits for multiple domestic-water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each domestic-water heater. Include shutoff valve and thermometer in each domestic-water heater inlet and outlet, and throttling valve in each domestic-water heater outlet. Comply with requirements for valves specified in Section 220523 "General-Duty Valves for Plumbing Piping" and comply with requirements for thermometers specified in Section 220500 "Common Work Results for Plumbing."

J. Install piping-type heat traps on inlet and outlet piping of domestic-water heater storage tanks without integral or fitting-type heat traps.

K. Fill domestic-water heaters with water.

L. Charge domestic-water expansion tanks with air to required system pressure.

M. Install dielectric fittings in all locations where piping of dissimilar metals is to be joined. The wetted surface of the dielectric fitting contacted by potable water shall contain less than 0.25 percent of lead by weight.

3.2 PIPING CONNECTIONS

A. Comply with requirements for domestic-water piping specified in Section 221116 "Domestic Water Piping."

B. Comply with requirements for fuel-oil piping specified in Section 231113 "Facility Fuel-Oil Piping."

C. Comply with requirements for gas piping specified in Section 231123 "Facility Natural-Gas Piping."

D. Drawings indicate general arrangement of piping, fittings, and specialties.

E. Where installing piping adjacent to fuel-fired, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. Testing Agency:

1. Owner will engage a qualified testing agency to perform tests and inspections.
2. Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections with the assistance of a factory-authorized service representative.

D. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Domestic-water heaters will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

3.5 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain commercial, gas-fired, storage, domestic-water heaters. Training shall be a minimum of one hour(s).

END OF SECTION 22 3400

SECTION 22 4200

COMMERCIAL PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Commercial lavatories.
2. Commercial showers.
3. Commercial sinks.
4. Commercial urinals.
5. Commercial water closets.
6. Flushometer valves.
7. Toilet seats.
8. Fixture carriers.

B. Related Requirements:

1. Section 114000 "Foodservice Equipment" for NSF-compliant foodservice and handwash sinks.

1.2 DEFINITIONS

A. FRP: Fiberglass-reinforced plastic.

B. High-Efficiency Flush Volume: 1.28 gal. or less per flush.

C. PMMA: Polymethyl methacrylate; also known as "acrylic."

D. Standard-Efficiency Flush Volume: 1.6 gal. per flush.

E. WaterSense Fixture: Water closet and/or flushometer valve/tank certified by the EPA to meet the WaterSense performance criteria.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Include construction details, material descriptions and thicknesses, dimensions of individual components and profiles, and finishes for plumbing fixtures.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings:

1. Plans, elevations, sections, and mounting details.

2. Details of equipment assemblies, including accessories. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, location and size of each field connection, location and size of each cutout, and anchorage provisions and attachment methods. Indicate coordination requirements for adjacent and interfacing Work.
3. Diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Counter cutout templates for mounting counter-mounted lavatories and/or counter-mounted sinks.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data:

1. For lavatories and faucets.

a. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1) Servicing and adjustments of automatic faucets.

2. For shower valves to include in maintenance manuals.
3. For sinks and faucets to include in operation and maintenance manuals.

a. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1) Servicing and adjustments of automatic faucets.

4. For flushometer valves and electronic sensors to include in operation and maintenance manuals.
5. For wash fountains and components to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Lavatory faucets, sink faucets, shower valves, and wash fountain spray heads and faucets intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), with requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. F-1 Lavatory, ADA:

1. Kohler K-2882, ADA vitreous china lavatory for under counter mounting with under deck clamp assembly, basin size of 19-13/16"x15-5/8". Color shall be Biscuit. All hardware and trim for fixture to be furnished and installed by the Plumbing Contractor.
2. Symmons #SLS-3510-0.5 lavatory faucet with washerless ceramic disc cartridge, polished chrome finish, deck plate, lever handle, 0.5 GPM aerator, no popup drain and open grid strainer, or approved TOTO equal.
3. McGuire #8902CNC polished chrome cast brass 1-1/4" tail piece or approved equal.
4. McGuire #8902C 1-1/4" cast brass P-trap with cleanout plug and polished chrome finish, or approved equal.
5. McGuire #LFH2165CC sweat angle stop supply valves with compression discharge fitting for extension to the faucet or approved equal.
6. Plumberex 'Pro Extreme' flexible white molded, closed cell PVC insulated waste and water supply piping covers complete with internal ribs, snap-lock fastening system and weep hole in base of trap. Supply valve cover shall be hinged for access or approved equal.

D. F-1B Lavatory, ADA:
1. Kohler K-2882, ADA vitreous china lavatory for under counter mounting with under deck clamp assembly, basin size of 19-13/16"x15-5/8". Color shall be Biscuit. All hardware and trim for fixture to be furnished and installed by the Plumbing Contractor.
2. Sloan #EAF-250, battery powered, deck-mounted mid-body, lavatory sensor faucet with infrared sensor, 30 second time out, 0.5 gpm laminar flow, open grid strainer, and polished chrome finish, or approved TOTO equal.
3. McGuire #8902CNC polished chrome cast brass 1-1/4" tail piece or approved equal.
4. McGuire #8902C 1-1/4" cast brass P-trap with cleanout plug and polished chrome finish or approved equal.
5. McGuire #LFH2165CC sweat angle stop supply valves with compression discharge fitting for extension to the faucet or approved equal.
6. Plumberex 'Pro Extreme' flexible white molded, closed cell PVC insulated waste and water supply piping covers complete with internal ribs, snap-lock fastening system and weep hole in base of trap. Supply valve cover shall be hinged for access or approved equal.

E. F-2 Drinking Fountain, ADA: **NOT USED**.

F. F-2A Drinking Fountain, ADA: **NOT USED**.

G. F-3 Water Closet, ADA:
1. Kohler #K-96057-96, ADA vitreous china floor set flush valve water closet with elongated bowl, siphon jet flushing, 2-1/4" passageway, 1-1/2" top spud. 18" fixture height. Color shall be Biscuit.
2. Sloan #8111-1.6G2 Optima Plus, battery powered, sensor operated, water closet flush valve, 1.6 gpf flush with chrome plating, metal cover, back check angle stop, top spud, adjustable tail piece, and vacuum breaker.
3. Kohler #K-4731-SC-96 solid plastic Biscuit color extra heavy-duty toilet seat without cover, with open front and self-sustaining check hinge.

H. F-4 Water Closet:
1. Kohler #K-96053-96 vitreous china floor set flush valve water closet with elongated bowl, siphon jet flushing, 2-1/8" passage way, 1-1/2" top spud. 15" fixture height. Color shall be Biscuit
2. Sloan #8111-1.6 G2 Optima Plus, battery powered, sensor operated, water closet flush valve,
3. 1.6 gpf flush with chrome plating, metal cover, back check angle stop, top spud, adjustable tail piece, and vacuum breaker.

4. Kohler #K-4731-SC-96 solid plastic Biscuit color extra heavy-duty toilet seat without cover, with open front and self-sustaining check hinge.

I. F-5 Water Closet:
1. Kohler #K-96064 vitreous china floor set flush valve water closet with elongated bowl, siphon jet flushing, 2-1/4" passageway, 1-1/2" top spud. 10” fixture height. Color shall be White.
2. Sloan #8111-1.6 G2 Optima Plus, battery powered, sensor operated, water closet flush valve,
3. 1.6 gpf flush with chrome plating, metal cover, back check angle stop, top spud, adjustable tail piece, and vacuum breaker.
4. Kohler #K-4686 solid plastic white toilet seat with scalloped handhold locations, less cover, with open front and self-sustaining check hinge.

J. F-6 Urinal:
1. Kohler #K-4991-ET-96, ADA vitreous china wall hung siphon jet 0.5 gpf urinal with 3/4" top spud inlet, 2" wall outlet and wall hangers. Color shall be Biscuit
2. Sloan #8186-1.0 G2 Optima Plus, battery powered, sensor operated, urinal flush valve, 1.0 gpf flush with chrome plating, metal cover, back check angle stop, adjustable tail piece, and vacuum breaker.

K. F-6A Urinal, ADA:
1. Kohler #K-4991-ET-96, ADA vitreous china wall hung siphon jet 0.5 gpf urinal with 3/4" top spud inlet, 2" wall outlet and wall hangers. Color shall be Biscuit
2. Sloan #8186-1.0 G2 Optima Plus, battery powered, sensor operated, urinal flush valve, 1.0 gpf flush with chrome plating, metal cover, back check angle stop, adjustable tail piece, and vacuum breaker.

L. F-7 Mop Sink:
1. Fiat #MSB-2424 molded stone mop service basin with 10" high walls complete with stainless steel strainer and drain for caulked connection.
2. Chicago #540-LD897SGC with check valves to prevent backflow, hot and cold wall mounted mixing faucet with vacuum breaker, spout with 3/4" hose threads, integral stop arms, chrome finish, and wall brace. NO EXCEPTIONS

M. F-8A Electric Water Cooler:
1. Elkay # EZSTL8C, Child dual height wall mounted electric water cooler complete with wall hanging bracket, stainless steel top, gray enclosure, push bar and bubbler assembly, cooling tank, dome grid strainer, hermetic compressor, condenser coil, evaporator, precooler, and shall be free from lead containing materials. Unit shall be designed for (1) water and waste connection.
2. McGuire #8902C 1-1/4" cast brass P-trap with cleanout plug and polished chrome finish or approved equal.
3. McGuire #LFH2165CC sweat angle stop supply valves with compression discharge fitting for extension to the faucet or approved equal.
4. Elkay #LKAPR-EZL apron for ADA compliance.

N. F-9 Drinking Fountain
1. Elkay #EDFP-19-C, semi-recessed stainless steel drinking fountain with perforated dome strainer, chrome tailpiece, flexiguard bubbler, self-closing front push bar control, and stainless-steel bottom cover plate.
2. McGuire #8902C 1-1/4" cast brass P-trap with cleanout plug and polished chrome finish or approved equal.
3. McGuire #LFH2165CC sweat angle stop supply valves with compression discharge fitting for extension to the faucet or approved equal.

O. F-9A Drinking Fountain, ADA
   1. Elkay #EDFP-19-C, ADA semi-recessed stainless steel drinking fountain with perforated dome strainer, chrome tailpiece, flexiguard bubbler, self-closing front push bar control, and stainless-steel bottom cover plate. High unit shall be furnished with a custom apron manufactured from #20 gauge type 302 stainless steel with satin finish to meet ADA requirements.
   2. McGuire #8902C 1-1/4" cast brass P-trap with cleanout plug and polished chrome finish or approved equal.
   3. McGuire #LFH2165CC sweat angle stop supply valves with compression discharge fitting for extension to the faucet or approved equal.

P. F-11 Sink:
   1. Elkay BPSR15 single compartment self rimming stainless-steel sink of seamlessly drawn 20 gauge type 302 stainless steel. The bowl shall be 6" deep, 1 3/4" radius corners, polished satin finish, heavy duty undercoating, recessed faucet deck with holes to match faucet, and 2" drain opening.
   2. Symmons #S-245-5-LWG two handlebar faucet with quarter turn ceramic control components, 4” wrist blade handles with red and blue indicators, 5-1/2" x 12-3/8” swivel/rigid spout with aerator, 0.5 gpm soft flow aerator. 1/2" IPS shanks, 4" centers, metal construction, polished chrome finish.
   3. Elkay #LK-36 basket strainer for 2" opening, strainer, neoprene stopper, and 1 1/2" cast brass tail piece.
   4. Kohler #K-9000 chrome plated cast brass P-trap with cleanout plug.
   5. McGuire #LFH2165CC sweat angle stop supply valves with compression discharge fitting for extension to the faucet or approved equal.

Q. F-11A Sink:
   1. Elkay #LR2219 single compartment self rimming stainless-steel sink of seamlessly drawn 20 gauge type 302 stainless steel. The bowl shall be 7.5" deep, 1 3/4" radius corners, polished satin finish, heavy duty undercoating, recessed faucet deck with holes to match faucet, and 3 1/2" drain opening.
   2. Kohler #K-30469-CP single side-lever faucet with pull-down sprayer, ceramic disc valve cartridge control, memory position valving, 8" gooseneck swivel/rigid spout with swing restriction pin and 1.5 gpm pull-down sprayer with adjustable spray pattern, 1/2" IPS shanks, integral check stops, brass construction, polished chrome finish.
   3. Elkay #LK-35 basket strainer for 3 1/2" opening, strainer, neoprene stopper, and 1 1/2" cast brass tail piece.
   4. Kohler #K-9000 chrome plated cast brass P-trap with cleanout plug.
   5. McGuire #LFH2165CC sweat angle stop supply valves with compression discharge fitting for extension to the faucet or approved equal.

R. F-11B Sink:
   1. Elkay #LRAD3319 double compartment self rimming stainless-steel sink of seamlessly drawn 20 gauge type 302 stainless steel. The bowl shall be 6.5" deep, 1 3/4" radius corners, polished satin finish, heavy duty undercoating, recessed faucet deck with single hole to match faucet, and 3 1/2" drain opening.
   2. Kohler #K-30469-CP single side-lever faucet with pull-down sprayer, ceramic disc valve cartridge control, memory position valving, 8" gooseneck swivel/rigid spout with swing restriction pin and 1.5 gpm pull-down sprayer with adjustable spray pattern, 1/2" IPS shanks, integral check stops, brass construction, polished chrome finish.
   3. Elkay #LK-35 basket strainer for 3 1/2" opening, strainer, neoprene stopper, and 1 1/2" cast brass tail piece.
   4. Kohler #K-9000 chrome plated cast brass P-trap with cleanout plug.
   5. McGuire #LFH2165CC sweat angle stop supply valves with compression discharge fitting for extension to the faucet or approved equal.

S. F-12 Shower:
   1. Moen #T8370+2328PF concealed, pressure balancing mixing valve with cast bronze body, Nonmetallic/nonferrous nylon replaceable cartridge, Chrome plated metal face plate, 14732 lever handle, temperature limit stops, color coded temperature scale, straight pattern threaded concealed check stops.
   2. Bricor Elite Series B150CH-R shower head 1.25 gpm at measured water pressure, NO EXCEPTIONS
   3. Note: Showerhead is specific to Lifetime and Plumbing Contractor is to contact Bricor directly at (707) 782-0226 for showerhead. Plumbing Contractor is required to measure water pressure at each end of shower bays and provide information to Bricor and Lifetime to ensure the head delivers 1.25 gpm at the measured water pressure at each shower.
   4. Speakman Repair Part 25-0276-PC-P enlarged elbow with 54-0079 anchor plate and 48-0216- MO (4) screws.
   5. Krage Manufacturing LLC, LTF - Aluminum Shower Valve insert/assembly for mason walls (NO EXCEPTIONS). Phone: 1-719-948-2002. Only PEX piping shall be used within assembly.

T. F-12A Shower, ADA: **NOT USED**.

U. F-12B Shower, ADA:
   1. Kohler K-28209 two-port Digitally controlled thermostatic mixing valve, Antiscald protection, concealed provide with access panel, prewired with two-prong plug for connection to 110 V AC receptacle. ASME A112.18.1/CSA B125.1, ASSE 1016/ASME A112.1016/CSA B125.16 and UL1951 compliant. 5-year Warranty.
   2. Kohler K-28214 digital shower interface, One touch control of temperature and flow. 1.75 gpm flow restrictor control, system warm-up and pause feature. Mounts on finished wall surface. Provide with 32ft. control cable. Architect to select color.
   3. Kohler #K-13689, 10” round rain showerhead, 1.75 gpm, polished chrome finish, ceiling mounted, 3” chrome shower arm and chrome escutcheon.

V. F-13 Shower, ADA:
   1. Moen #T8370+2328PF concealed pressure balancing mixing valve with cast bronze body, nonmetallic/nonferrous nylon replaceable cartridge, Chrome plated metal face plate, 14732 lever handle, temperature limit stops, color coded temperature scale, straight pattern threaded concealed check stops.
   2. Delta RPW336HDF handheld shower assembly less head with 36” stainless steel slide/grad bar with mounting screws and metal adjustable slide attachment. Refer to Architectural documents for mounting heights, 69” double spiral metal hand-shower hose; and 90° chrome-plated wall supply elbow with vacuum breaker, less shower head.
   3. Speakman Repair Part 25-0276-PC-P enlarged elbow with 54-0079 anchor plate and 48-0216- MO (4) screws.
   4. Bricor – Elite Series B150CH-HH handheld shower head 1.25 gpm at measured water pressure, NO EXCEPTIONS.
   5. Note: Showerhead is specific to Lifetime and Plumbing Contractor is to contact Bricor directly at (707) 782-0226 for showerhead. Plumbing Contractor is required to measure water pressure at each end of shower bays and provide information to Bricor and Lifetime to ensure the head delivers 1.25 gpm at the measured water pressure at each shower. Refer to Architectural documents for mounting heights.
   6. Krage Manufacturing LLC, LTF - Aluminum Shower Valve insert/assembly for mason walls (NO EXCEPTIONS). Phone: 1-719-948-2002. Only PEX piping shall be used within assembly.

W. F-13A Shower:
   1. Moen #T8370+2328PF concealed pressure balancing mixing valve with cast bronze body, nonmetallic/nonferrous nylon replaceable cartridge, Chrome plated metal face

plate, 14732 lever handle, temperature limit stops, color coded temperature scale, straight pattern threaded concealed check stops.
2. Delta U495d-60-PK stainless steel 60"-82" hose. Provide with chrome finish.
3. Delta RP61294PR hand shower mount. Provide with lumicoat chrome finish.
4. Speakman Repair Part 25-0276-PC-P enlarged elbow with 54-0079 anchor plate and 48-0216- MO (4) screws.
5. Bricor – Elite Series B150CH-HH handheld shower head 1.25 gpm at measured water pressure, NO EXCEPTIONS.
6. Note: Showerhead is specific to Lifetime and Plumbing Contractor is to contact Bricor directly at (707) 782-0226 for showerhead. Plumbing Contractor is required to measure water pressure at each end of shower bays and provide information to Bricor and Lifetime to ensure the head delivers 1.25 gpm at the measured water pressure at each shower. Maximum showerhead height is to be 48".
7. Krage Manufacturing LLC, LTF - Aluminum Shower Valve insert/assembly for mason walls (NO EXCEPTIONS). Phone: 1-719-948-2002. Only PEX piping shall be used within assembly.

X. F-14 Salon Sink:
1. Bowl: MPI #9860214WC
2. Supplier: Spa Interiors MPI.
   a. Contact: Chris Erickson – chris@spainteriors.com
3. Vacuum breaker by Spa Interiors
4. Accessories:
   a. Hair trap provided by the plumber.

Y. F-15 Pedicure Sink:
1. Fixture furnished by others, installed by Plumbing Contractor.

Z. F-16 Water Closet, ADA**: NOT USED**.

AA. F-17 Water Closet: **NOT USED**.

BB. F-18 Electric Water Cooler with Bottle Filler, ADA:
1. Elkay EZH2O #EZSTL8WS, ADA dual wall mounted electric water cooler with sensor operated bottle filling station. Water cooler complete with wall hanging bracket, stainless steel top, gray enclosure, push bar on front, left, and right, bubbler assembly, cooling tank, dome grid strainer, hermetic compressor, condenser coil, evaporator, precooler, and shall be free from lead containing materials. Bottle filler shall be surface mounted with drain affixed to water cooler, anti-microbial plastic components, 1.5 gpm laminar flow, 30 second shutoff timer, and vandal- resistant bubbler. Mount bottle filler above non-ADA electric water cooler. Bottle filler shall not have a water filter or filter status light.
2. McGuire #8902C 1-1/4" cast brass P-trap with cleanout plug and polished chrome finish or approved equal.
3. McGuire #LFH2165CC sweat angle stop supply valves with compression discharge fitting for extension to the faucet or approved equal.
4. Elkay #LKAPR-EZL apron for ADA compliance.

CC. F-19 Emergency Eyewash Station
1. Stingray T2210 epoxy coated, pedestal eyewash station with integral emergency thermostatic mixing valve, stainless steel bowl, (2) aerated sprayers w/ dust covers, 1/2" NPT connections, push handle, 1-1/4” IPS drain connection, floor mounting flange, no filter, certified to meet ANSI Z358.1 requirements.

DD. F-20 Emergency Eyewash/Shower:
1. Stingray T5510-EP epoxy coated floor mounted combination shower and eye/face wash system with stainless steel bow, First Air Red ABS shower head and spray heads w/ duct

covers, positive hot water shutoff, 1” hot and cold water connection inlets with check valves, integrated emergency thermostatic mixing valve with capacity for 20 gpm flow, stainless steel pull rod with handle, 8” diameter anchored floor mounting base plate shall be certified to meet ANSI Z358.1 requirement.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water-supply piping and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.

B. Examine walls and floors for suitable conditions where plumbing fixtures will be installed.

C. Examine counters for suitable conditions where lavatories and sinks will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF COMMERCIAL PLUMBING FIXTURES

A. Lavatory Installation:

1. Install lavatories level and plumb in accordance with roughing-in drawings.
2. Install supports, affixed to building substrate, for wall-mounted lavatories.
3. Install accessible, wall-mounted lavatories at mounting height in accordance with ICC A117.1.
4. Install water-supply piping with stop on each supply to each lavatory faucet. Install stops in locations that are accessible for ease of operation.
5. Install trap and waste piping on each drain outlet of each lavatory to be connected to sanitary drainage system.
6. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220500 "Common Work Results for Plumbing."
7. Seal joints between lavatories, counters, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."
8. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

B. Shower Installation:

1. Assemble shower components in accordance with manufacturers' written instructions.
2. Install showers level and plumb in accordance with roughing-in drawings.
3. Install ball valves in water-supply piping to the shower if supply stops are specified with the shower valve. Comply with ball valve requirements specified in Section 220523 "General Duty Valves for Plumbing Piping." Install valves in locations that are accessible for ease of operation.
4. Install shower flow-control fittings with specified maximum flow rates in shower arms.
5. Set shower receptors and shower basins in leveling bed of cement grout.

6. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220500 "Common Work Results for Plumbing."
7. Showers, except Cast-Polymer Showers: Seal joints between showers, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."
8. Cast-Polymer Showers: Adhere panels to drywall using shower manufacturer's recommended adhesive. Seal joints, between panels and between panels and adjacent drywall, using shower manufacturer's recommended caulking specific for each application. Match sealant to fixture color.

C. Sink Installation:

1. Install sinks level and plumb in accordance with roughing-in drawings.
2. Install supports, affixed to building substrate, for wall-mounted sinks.
3. Install accessible, wall-mounted sinks at mounting height in accordance with ICC A117.1.
4. Set floor-mounted sinks in leveling bed of cement grout.
5. Install water-supply piping with stop on each supply to each sink faucet.

    a. Exception: Use ball or gate valves if supply stops are not specified with sink. Comply with valve requirements specified in Section 220523 "General Duty Valves for Plumbing Piping."
    b. Install stops/valves in locations that are accessible for ease of operation.

6. Install trap and waste piping on each drain outlet of each sink to be connected to sanitary drainage system.
7. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220500 "Common Work Results for Plumbing."
8. Seal joints between sinks, counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."
9. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

D. Urinal Installation:

1. Install urinals level and plumb in accordance with roughing-in drawings.
2. Install wall-hung, back-outlet urinals onto waste-fitting seals and attached to supports.
3. Install wall-hung, bottom-outlet urinals with tubular waste piping attached to supports.
4. Install accessible, wall-mounted urinals at mounting height in accordance with ICC A117.1.
5. Install trap-seal liquid in waterless urinals.
6. Install supports, affixed to building substrate, for wall-hung urinals.
7. Use off-floor carriers with waste fitting and seal for back-outlet urinals.
8. Use carriers without waste fitting for urinals with tubular waste piping.
9. Use chair-type carrier supports with rectangular steel uprights for accessible urinals.
10. Measure support height installation from finished floor, not structural floor.
11. Install flushometer-valve, water-supply fitting on each supply to each urinal.
12. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
13. Install lever-handle flushometer valves for accessible urinals with handle mounted on open side of compartment.

14. Install actuators in locations easily reachable for people with disabilities.
15. Install new batteries in battery-powered, electronic-sensor mechanisms.
16. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Install deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220500 "Common Work Results for Plumbing."
17. Seal joints between urinals, walls, and floors using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to urinal color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

E. Water Closet Installation:

1. Install water closets level and plumb in accordance with roughing-in drawings.
2. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.
3. Install accessible, wall-mounted water closets at mounting height in accordance with ICC A117.1.
4. Install supports, affixed to building substrate, for floor-mounted, back-outlet water closets.
5. Use carrier supports with waste-fitting assembly and seal.
6. Install floor-mounted, back-outlet water closets, attached to building floor substrate, onto waste-fitting seals; and attach to support.
7. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals, and affix to building substrate.
8. Measure support height installation from finished floor, not structural floor.
9. Install flushometer-valve, water-supply fitting on each supply to each water closet.
10. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
11. Install lever-handle flushometer valves for accessible water closets with handle mounted on open side of water closet.
12. Install actuators in locations easily reachable for people with disabilities.
13. Install new batteries in battery-powered, electronic-sensor mechanisms.
14. Install toilet seats on water closets.
15. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Install deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220500 "Common Work Results for Plumbing."
16. Seal joints between water closets, walls, and floors using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to water-closet color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

F. Wash Fountain Installation:

1. Install wash fountains level and plumb in accordance with roughing-in drawings.
2. Set freestanding wash fountains on floor.
3. Install off-floor carrier supports, affixed to building substrate, for wall-mounted wash fountains.
4. Install accessible, wall-mounted wash fountains at mounting height in accordance with ICC A117.1.
5. Install water-supply piping with shutoff valve on each supply to each wash fountain faucet. Use ball or gate valves if supply stops are not specified with wash fountain. Comply with valve requirements specified in Section 220523 "General Duty Valves for Plumbing Piping." Install stops/valves in locations that are accessible for ease of operation.
6. Install trap and waste piping on each drain outlet of each wash fountain to be connected to sanitary drainage system.
7. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply

with escutcheon requirements specified in Section 220500 "Common Work Results for Plumbing."

8. Seal joints between wash fountains, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."
9. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.3 INSTALLATION OF PIPING CONNECTIONS

A. Connect plumbing fixtures with water supplies and soil, waste, and vent piping. Use size fittings required to match plumbing fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil, waste, and vent piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

D. Install protective-shielding pipe covers and enclosures on exposed supplies and waste piping of accessible plumbing fixtures. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

E. Where installing piping adjacent to water closets and urinals, allow space for service and maintenance.

3.4 INSTALLATION OF ELECTRICAL CONNECTIONS

A. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

C. Install electrical devices furnished by manufacturer, but not factory mounted in accordance with NFPA 70 and NECA 1.

D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

1. Nameplate to be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."
2. Nameplate to be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

3.5 INSTALLATION OF CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring in accordance with Section 260523 "Control-Voltage Electrical Power Cables."

3.6 ADJUSTING

A. Operate and adjust plumbing fixtures and controls. Replace damaged and malfunctioning plumbing fixtures, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

C. Adjust water pressure at shower valves to produce proper flow.

D. Adjust water pressure at flushometer valves to produce proper flow.

E. Install new batteries in battery-powered, electronic-sensor mechanisms.

3.7 CLEANING AND PROTECTION

A. After completing installation of plumbing fixtures, inspect and repair damage to finishes. Replace any fixtures unable to be repaired to the satisfaction of the Owner.

B. Clean plumbing fixtures and associated faucets, valves, flushometer valves, and fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed plumbing fixtures and associated faucets, valves, flushometer valves, and fittings.

D. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 22 4200

SECTION 22 5213

STEAM ROOM GENERATORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Steam room generator.
   2. Steam room generator accessories.

1.2 SUBMITTALS

A. Product Data: For each type and size of steam generator indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Operation and maintenance data.

D. Warranty.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial heat exchangers to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

C. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9" for all components that will be in contact with potable water.

1.4 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of steam generator that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures including storage tank and supports.
      b. Faulty operation of controls.
      c. Deterioration of metals, metal finishes, and other materials beyond normal use.
   2. Warranty Period(s): From date of Substantial Completion: One year.

PART 2 - PRODUCTS

2.1 STEAM ROOM GENERATOR

A. Circulating, Storage Heat Exchangers:
   1. Manufacturers:
      a. Lattner: Model BF-48 ASME.
   2. Description: Packaged, electric, horizontal steam generator. Each single unit factory mounted, installed, and piped on a single rack.
   3. Heating Element: 48 kw
   4. Power Requirement: 480 Volt, 3 phase power
   5. Reservoir: Carbon steel
   6. Accessories:
      a. Auto drain valve.
      b. Timed automatic blow down.
      c. Pressure switch.
      d. Pressure limit switch.
      e. Complete packaged controls.
      f. Remote room sensor.
      g. Low voltage temperature/time remote controller.
      h. Water level probe and electric water solenoid valve.
   7. Distribution Piping: Each unit shall have a NPS 1/2 (DN 15) make-up water pipe, complete with NPS 1-1/4 (DN 32) branch steam pipe to each steam room with a steam head.
   8. Units shall be installed and piped as noted in the detail on the plan.

2.2 STEAM ROOM GENERATOR ACCESSORIES

A. Aroma Tank (to be furnished by owner):
   1. Manufacturers:
      a. Accurate Industries, AromaMist AI-7, or approved equal.
   2. Description: Packaged aroma tank assembly consisting of 34-gallon reservoir, removable lid, 120v pump and tubing.

PART 3 - EXECUTION

3.1 STEAM GENERATOR INSTALLATION

A. Install steam generators level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturers' recommended clearances. Arrange units so controls and devices needing service are accessible.

B. Anchor steam generators to substrate.

C. Install makeup water, steam distribution piping and steam head for each steam generator. Steam distribution piping from each steam generator shall be NPS 1-1/4 (DN 32) branch steam pipe to each steam room. Plumbing Contractor shall install connect NPS 1/2 (DN 15) steam nozzle (furnished by equipment supplier) to NPS 1-1/4 (DN 32) branch pipe with bushing at wall in location shown on plan.

D. Install steam generator drain piping as indirect waste to spill by positive air gap into floor sink. Install hose-end drain valves at low points in water piping for steam generator that do not have tank drains. Refer to Division 22 Section "Plumbing Specialties" for hose-end drain valves.

E. Install NPS 1/2 (DN 15) male fitting in steam discharge line of each steam generator for owners in- scent injector.

F. Install aroma tank and pipe to male fitting in steam discharge line.

G. Fill steam generators with water.

3.2 CONNECTIONS

A. Install piping adjacent to steam generator to allow service and maintenance. Arrange piping for easy removal of steam generators.

B. Ground equipment according to Division 26 Section "Grounding and Bonding."

C. Connect wiring according to Division 26 Section "Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field- assembled components and equipment installation, including connections.

B. Perform the following field tests and inspections and prepare test reports:
   1. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
   2. Operational Test: After electrical circuitry has been energized, confirm proper operation.
   3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace steam generators that do not pass tests and inspections and retest as specified above.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain steam generators. Refer to Division 1 Section "Contract Closeout."

END OF SECTION 22 5213

SECTION 23 0500

COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Motors.
2. Packed expansion joints.
3. Packless expansion joints.
4. Sleeves without waterstop.
5. Sleeves with waterstop.
6. Stack-sleeve fittings.
7. Sleeve-seal systems.
8. Grout.
9. Access Panels.
10. Silicone sealants.
11. Escutcheons.
12. Thermometers, liquid in glass.
13. Thermowells.
14. Pressure gauges, dial type.
15. Gauge attachments.
16. Test plugs.
17. Test-plug kits.
18. Sight flow indicators.
19. Flowmeters.
20. Thermal-energy meters.

B. Related Requirements:

1. Section 231123 "Facility Natural-Gas Piping" for gas meters.

1.2 ACTION SUBMITTALS

A. Product Data:

1. For each type of product, excluding motors which are included in Part 1 of HVAC equipment Sections.

    a. Include construction details, material descriptions, and dimensions of individual components, and finishes.
    b. Include operating characteristics and furnished accessories.

1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of meter.

B. Welding certificates.

C. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of expansion joint, and gauge to include in operation and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.

B. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators in accordance with 2021 ASME Boiler and Pressure Vessel Code, Section IX.

1.6 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 MOTORS

A. Motor Requirements, General:

1. Content includes motors for use on alternating-current power systems of up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.
2. Comply with requirements in this Section except when stricter requirements are specified in equipment schedules or Sections.
3. Comply with NEMA MG 1 unless otherwise indicated.
4. Comply with IEEE 841 for severe-duty motors.

B. Motor Characteristics:

1. Duty: Continuous duty at ambient temperature of 40 deg C and at site altitude.
2. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

C. Polyphase Motors:

1. Description: NEMA MG 1, Design B, medium induction motor.
2. Efficiency: Premium Efficient, as defined in NEMA MG 1.
3. Service Factor: 1.15.
4. Multispeed Motors: Variable torque.

    a. For motors with 2:1 speed ratio, consequent pole, single winding.
    b. For motors with other than 2:1 speed ratio, separate winding for each speed.
5. Rotor: Random-wound, squirrel cage.
6. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
7. Temperature Rise: Match insulation rating.
8. Insulation: Class F.
9. Code Letter Designation:

    a. Motors 15 Hp and Larger: NEMA starting Code F or Code G.
    b. Motors Smaller Than 15 Hp: Manufacturer's standard starting characteristic.

10. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

D. Additional Requirements for Polyphase Motors:

1. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
2. Motors Used with Variable-Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

    a. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time-rise pulses produced by pulse-width-modulated inverters.
    b. Premium-Efficient Motors: Class B temperature rise; Class F insulation.
    c. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
    d. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

3. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

E. Single-Phase Motors:

1. Motors larger than 1/20 hp must be one of the following, to suit starting torque and requirements of specific motor application:

    a. Permanent-split capacitor.
    b. Split phase.
    c. Capacitor start, inductor run.
    d. Capacitor start, capacitor run.

2. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
3. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
4. Motors 1/20 hp and Smaller: Shaded-pole type.
5. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of

motor insulation. Thermal-protection device will automatically reset when motor temperature returns to normal range.

2.2 EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

A. Performance Requirements:

1. Compatibility: Provide products suitable for piping service fluids, materials, working pressures, and temperatures.
2. Capability: Provide products and installations that will accommodate maximum axial movement as scheduled or indicated on Drawings.

B. Packed Expansion Joints:

1. Flexible, Ball-Joint Packed Expansion Joints: FBJ-01.
   a. Source Limitations: Obtain rubber union connector expansion joints from single manufacturer.
   b. Standards: 2021 ASME Boiler and Pressure Vessel Code: Section II, "Materials"; ASME B31.9 for materials and design of pressure-containing parts and bolting.
   c. Material: Carbon-steel assembly with asbestos-free composition packing.
   d. Design: Provide 360-degree rotation and angular deflection.
   e. Minimum Pressure Rating: 250 psig at 400 deg F.
   f. Angular Deflection for NPS 6 (DN 150) and Smaller: 30 degrees minimum.
   g. Angular Deflection for NPS 8 (DN 200) and Larger: 15 degrees minimum.
   h. Seal Type: Two carbon-steel and graphite seals suitable for continuous operation at temperature up to 650 deg F.
   i. Internal Ball: Plated with minimum 1-mil chrome cover.
   j. Ball Socket: One- or two-piece design with integral socket/retainer.
      1) Stuffing Box: Incorporates containment seals and compression seals for containment of injectable packing.
      2) Packing Cylinders: Provides packing under full line pressure with check valves to prevent blowback.
   k. End Connections for NPS 2 (DN 50) and Smaller: Threaded.
   l. End Connections for NPS 2-1/2 (DN 65) and Larger: Flanged.

2. Slip-Joint Packed Expansion Joints: SJ-01.
   a. Source Limitations: Obtain slip-joint packed expansion joints from single manufacturer.
   b. Standard: ASTM F1007.
   c. Material: Carbon steel with asbestos-free PTFE packing.
   d. Design: With internal guide and injection ports for repacking under full system pressure. Housing is to be furnished with drain ports and lifting ring. Include drip connection if used for steam piping.
   e. Configuration: Single joint class(es) unless otherwise indicated.
   f. Slip Tube for Sizes NPS 1-1/2 (DN 40) through NPS 16 (DN 400): Schedule 80.
   g. Slip Tube for Sizes NPS 18 (DN 450) through NPS 24 (DN 600): Schedule 60.
   h. Sliding Surface: 2-mil-thick chrome finish.
   i. End Connections: Flanged or welded ends to match piping system.

C. Packless Expansion Joints:

1. Metal, Compensator Packless Expansion Joints: MCEJ-01.

a. Source Limitations: Obtain metal compensator packless expansion joints from single manufacturer.
b. Minimum Pressure Rating: 175 psig unless otherwise indicated.
c. Description: Totally enclosed, externally pressurized, multi-ply bellows isolated from fluid flow by an internal pipe sleeve and external housing.
d. Joint Axial Movement: 2 inches of compression and 1/2 inch of extension.
e. Configuration for Copper Tubing: Multi-ply, phosphor-bronze bellows with copper pipe ends.

1) End Connections for Copper Tubing NPS 2 (DN 50) and Smaller: threaded.
2) End Connections for Copper Tubing NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Threaded.

f. Configuration for Steel Piping: Multi-ply, stainless steel bellows; steel-pipe end connections; and carbon-steel shroud.

1) End Connections for Steel Pipe NPS 2 (DN 50) and Smaller: Threaded.
2) End Connections for Steel Pipe NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged.

2. Flexible-Hose Packless Expansion Joints: FHEJ-01.
a. Source Limitations: Obtain flexible-hose packless expansion joints from single manufacturer.
b. Description: Manufactured assembly with inlet and outlet elbow fittings and two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose.
c. Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.
d. Expansion Joints for Copper Tubing NPS 2 (DN 50) and Smaller: Copper-alloy fittings with solder-joint end connections.

1) Bronze hoses and single-braid bronze sheaths with 450 psig at 70 deg F and 340 psig at 450 deg F ratings.
2) Bronze hoses and double-braid bronze sheaths with 700 psig at 70 deg F and 500 psig at 450 deg F ratings.

e. Expansion Joints for Copper Tubing NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Copper-alloy fittings with threaded end connections.

1) Stainless steel hoses and single-braid, stainless steel sheaths with 300 psig at 70 deg F and 225 psig at 450 deg F ratings.
2) Stainless steel hoses and double-braid, stainless steel sheaths with 420 psig at 70 deg F and 315 psig at 450 deg F ratings.

f. Expansion Joints for Steel Piping NPS 2 (DN 50) and Smaller: Carbon-steel fittings with threaded end connections.

1) Stainless steel hoses and single-braid, stainless steel sheaths with 450 psig at 70 deg F and 325 psig at 600 deg F ratings.
2) Stainless steel hoses and double-braid, stainless steel sheaths with 700 psig at 70 deg F and 515 psig at 600 deg F ratings.

g. Expansion Joints for Steel Piping NPS 2-1/2 to NPS 6 (DN 65 to DN 150): Carbon-steel fittings with flanged end connections.

1) Stainless steel hoses and single-braid, stainless steel sheaths with 200 psig at 70 deg F and 145 psig at 600 deg F ratings.
2) Stainless steel hoses and double-braid, stainless steel sheaths with 275 psig at 70 deg F and 200 psig at 600 deg F ratings.

h. Expansion Joints for Steel Piping NPS 8 to NPS 12 (DN 200 to DN 300): Carbon steel fittings with flanged end connections.

1) Stainless steel hoses and single-braid, stainless steel sheaths with 125 psig at 70 deg F and 90 psig at 600 deg F ratings.
2) Stainless steel hoses and double-braid, stainless steel sheaths with 165 psig at 70 deg F and 120 psig at 600 deg F ratings.

i. Expansion Joints for Steel Piping NPS 14 (DN 350) and Larger: Carbon-steel fittings with flanged end connections.

1) Stainless steel hoses and double-braid, stainless steel sheaths with 165 psig at 70 deg F and 120 psig at 600 deg F ratings.

3. Metal-Bellows Packless Expansion Joints: MBEJ-01.
a. Source Limitations: Obtain metal-bellows packless expansion joints from single manufacturer.
b. Standards: ASTM F1120 and EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."
c. Type: Circular, corrugated bellows with external tie rods.
d. Minimum Pressure Rating: 175 psig unless otherwise indicated.
e. Configuration: Single joint class(es), unless otherwise indicated.
f. Expansion Joints for Copper Tubing: Single-ply phosphor-bronze bellows, copper pipe ends, and brass shrouds.

1) End Connections for Copper Tubing NPS 2 (DN 50) and Smaller: threaded.
2) End Connections for Copper Tubing NPS 2-1/2 to NPS 4 (DN 65 to DN 100): threaded.
3) End Connections for Copper Tubing NPS 5 (DN 125) and Larger: Flanged.

g. Expansion Joints for Steel Piping: Single-ply stainless steel bellows, steel pipe ends, and carbon steel shroud.

1) End Connections for Steel Pipe NPS 2 (DN 50) and Smaller: Threaded.
2) End Connections for Steel Pipe NPS 2-1/2 (DN 65) and Larger: Flanged.

2.3 SLEEVES AND SLEEVE SEALS

A. Sleeves without Waterstop:

1. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron, with plain ends.
2. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, hot-dip galvanized, with plain ends.
3. Steel Sheet Sleeves: ASTM A653/A653M, 24 gauge minimum thickness; hot-dip galvanized, round tube closed with welded longitudinal joint.
4. PVC Pipe Sleeves: ASTM D1785, Schedule 40.
5. Molded-PVC Sleeves: With nailing flange.
6. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange.

B. Sleeves with Waterstop:
   1. Description: Manufactured PVC/HDPE, sleeve-type, waterstop assembly, made for imbedding in concrete slab or wall.

C. Stack-Sleeve Fittings:
   1. Description: Manufactured, galvanized cast-iron sleeve with integral cast flashing flange for use in waterproof floors and roofs. Include clamping ring, bolts, and nuts for membrane flashing.

      a. Underdeck Clamp: Clamping ring with setscrews.

D. Sleeve-Seal Systems:
   1. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

      a. Hydrostatic seal: 20 psig.
      b. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size.
      c. Pressure Plates: Carbon steel.
      d. Connecting Bolts and Nuts: Carbon steel, with zinc coating. ASTM B633 of length required to secure pressure plates to sealing elements.

E. Grout:

   1. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.
   2. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
   3. Design Mix: 5000 psi, 28-day compressive strength.
   4. Packaging: Premixed and factory packaged.

F. Silicone Sealants:

   1. Silicone Sealant, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant.
      a. Standard: ASTM C920, Type S, Grade NS, Class 25, Use NT.

   2. Silicone Sealant, S, P, T, NT: Single-component, 25, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant.
      a. Standard: ASTM C920, Type S, Grade P, Class 25, Uses T and NT.

   3. Silicone Foam Sealant: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

2.4 ACCESS PANELS

A. Access panels shall be Cesco, or approved, as follows:
   1. Type W 16” x 16”min.
   2. Type P or PX 16” x 16”min.
   3. Type SR 14” x 14”min.
   4. Type ACRX 24” x 24”min.
   5. Type AP-FR, 1-1/2 hour B label.

2.5 ESCUTCHEONS

A. Escutcheon Types:
   1. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
   2. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished, chrome-plated finish and spring-clip fasteners.
   3. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed hinge; and spring-clip fasteners.

B. Floor Plates:

   1. Split Floor Plates: Steel with concealed hinge.

2.6 METERS AND GAUGES FOR HVAC PIPING

A. Thermometers, Liquid-in-Glass - Metal Case, Compact Style:
   1. Source Limitations: Provide liquid-in-glass, metal-case, compact-style thermometers by single manufacturer.
   2. Standard: ASME B40.200.
   3. Case: Cast aluminum; 6-inch nominal size.
   4. Case Form: Back angle unless otherwise indicated.
   5. Tube: Glass with magnifying lens and blue organic liquid.
   6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
   7. Window: Glass or plastic.
   8. Stem: Aluminum or brass and of length to suit installation.

      a. Design for Air-Duct Installation: With ventilated shroud.
      b. Design for Thermowell Installation: Bare stem.

   9. Connector: 3/4 inch, with ASME B1.1 screw threads.
   10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

B. Thermowells:

   1. Standard: ASME B40.200.
   2. Description: Pressure-tight, socket-type fitting made for insertion in piping tee fitting.
   3. Material for Use with Copper Tubing: CNR or CUNI.
   4. Material for Use with Steel Piping: CRES.
   5. Type: Stepped shank unless straight or tapered shank is indicated.
   6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
   7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
   8. Bore: Diameter required to match thermometer bulb or stem.
   9. Insertion Length: Length required to match thermometer bulb or stem.
   10. Lagging Extension: Include on thermowells for insulated piping and tubing.
   11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.
   12. Heat-Transfer Medium: Mixture of graphite and glycerin.

C. Pressure Gauges, Dial Type - Direct Mounted, Metal Case:
   1. Source Limitations: Provide dial-type, direct-mounted, metal-case pressure gauges from single manufacturer.
   2. Standard: ASME B40.100.

3. Case: Liquid-filled type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube.
5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanent scale markings graduated in psi.
8. Pointer: Dark-colored metal.
9. Window: Glass.
10. Ring: Metal.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of span.

D. Gauge Attachments:

1. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and porous-metal-type surge-dampening device. Include extension for use on insulated piping.
2. Siphons: Loop-shaped section of brass pipe with NPS 1/4 or NPS 1/2 pipe threads.
3. Valves: Brass ball, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

E. Test Plugs:
1. Source Limitations: Provide test plugs from single manufacturer.
2. Description: Test-station fitting made for insertion in piping tee fitting.
3. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
4. Thread Size: NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe thread.
5. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.
6. Core Inserts: EPDM self-sealing rubber.

F. Test-Plug Kits:
1. Source Limitations: Provide test-plug kits from single manufacturer.
2. Furnish one test-plug kit(s) containing one thermometer(s), one pressure gauge and adapter, and carrying case. Thermometer sensing elements, pressure gauge, and adapter probes are to be of diameter to fit test plugs and of length to project into piping.
3. Low-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch-diameter dial and tapered-end sensing element. Dial range is to be at least 25 to 125 deg F.
4. High-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch-diameter dial and tapered-end sensing element. Dial range is to be at least 0 to 220 deg F.
5. Pressure Gauge: Small, Bourdon-tube insertion type with 2- to 3-inch-diameter dial and probe. Dial range shall be at least 0 to 200 psig.
6. Carrying Case: Metal or plastic, with formed instrument padding.

PART 3 - EXECUTION

3.1 INSTALLATION OF EXPANSION JOINTS - GENERAL

A. Install expansion joints of sizes matching sizes of piping in which they are installed.

3.2 INSTALLATION OF PACKED EXPANSION JOINTS

A. Install packed expansion joints with packing suitable for fluid service.

3.3 INSTALLATION OF PACKLESS EXPANSION JOINTS

A. Install metal-bellows packless expansion joints in accordance with EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."

B. Install rubber packless expansion joints in accordance with FSA-PSJ-703.

3.4 INSTALLATION OF ALIGNMENT GUIDES AND ANCHORS

A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.

B. Install one guide(s) on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.

C. Attach guides to pipe, and secure guides to building structure.

D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

E. Anchor Attachments:

1. Anchor Attachment to Steel Pipe: Attach by welding. Comply with ASME B31.9.
2. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-58, Type 24; U bolts bolted to anchor.

F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.

1. Anchor Attachment to Steel Structural Members: Attach by welding.
2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.
3. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

3.5 INSTALLATION OF PIPE LOOPS AND SWING CONNECTIONS

A. Install pipe loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.

B. Connect risers and branch connections to mains with at least five pipe fittings, including tee in main.

C. Connect risers and branch connections to terminal units with at least four pipe fittings, including tee in riser.

D. Connect mains and branch connections to terminal units with at least four pipe fittings, including tee in main.

3.6 INSTALLATION OF SLEEVES - GENERAL

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

1. Sleeves are not required for core-drilled holes.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
2. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.

3. Using grout or silicone sealant, seal space outside of sleeves in floors/slabs/walls without sleeve-seal system. Select to maintain fire resistance of floor/slab/wall.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants that joint sealant manufacturer's literature indicates is appropriate for size, depth, and location of joint.

E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke-Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping."

3.7 INSTALLATION OF SLEEVES WITH WATERSTOP

A. Install sleeve with waterstop as new walls and slabs are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange centered across width of concrete slab or wall.

C. Secure nailing flanges to wooden concrete forms.

D. Using grout or silicone sealant, seal space around outside of sleeves.

3.8 INSTALLATION OF STACK-SLEEVE FITTINGS

A. Install stack-sleeve fittings in new slabs as slabs are constructed.

1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."

3. Install section of cast-iron soil pipe to extend sleeve to 3 inches above finished floor level.
4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
5. Using silicone sealant, seal space between top hub of stack-sleeve fitting and pipe.

B. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.9 INSTALLATION OF SLEEVE-SEAL SYSTEMS

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building, and passing through exterior walls.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.10 INSTALLATION OF ESCUTCHEONS

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.

3.11 INSTALLATION OF METERS AND GAUGES

A. Install thermowells with socket extending a minimum of 2 inches into fluid and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing, and support tubing to prevent kinks. Use minimum tubing length.

G. Install pipe-mounted thermal-energy temperature sensors in thermowells and extend wiring to indicator.

H. Install duct-thermometer-mounting brackets in walls of ducts. Attach to duct with screws.

I. Install direct-mounted pressure gauges in piping tees with pressure gauge located on pipe at the most readable position.

J. Install remote-mounted pressure gauges on panel.

K. Install valve and snubber in piping for each pressure gauge for fluids (except steam).

L. Install valve and syphon fitting in piping for each pressure gauge for steam.

M. Install test plugs in piping tees.

N. Install flow indicators in piping systems in accessible positions for easy viewing.

O. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters according to manufacturer's written instructions.

P. Install flowmeter elements in accessible positions in piping systems.

Q. Install wafer-orifice flowmeter elements between orifice-type pipe flanges.

R. Install permanent indicators on walls or brackets in accessible and readable positions.

S. Install connection fittings in accessible locations for attachment to portable indicators.

T. Mount thermal-energy meters on wall if accessible; if not, provide brackets to support meters.

U. Install thermometers in the following locations:

1. Inlet and outlet of each hydronic zone.
2. Inlet and outlet of each hydronic boiler.
3. Two inlets and two outlets of each chiller.
4. Inlet and outlet of each hydronic coil in air-handling units.
5. Two inlets and two outlets of each hydronic heat exchanger.
6. Inlet and outlet of each thermal-storage tank.
7. Outside-, return-, supply-, and mixed-air ducts.

V. Install pressure gauges in the following locations:

1. Discharge of each pressure-reducing valve.
2. Inlet and outlet of each chiller chilled-water and condenser-water connection.
3. Suction and discharge of each pump.

3.12 CONNECTIONS

A. Install meters and gauges adjacent to machines and equipment to allow space for service and maintenance of meters, gauges, machines, and equipment.

B. Connect flowmeter-system elements to meters.

C. Connect flowmeter transmitters to meters.

D. Connect thermal-energy meter transmitters to meters.

3.13 ADJUSTING

A. After installation, calibrate meters according to manufacturer's written instructions.

B. Adjust faces of meters and gauges to proper angle for best visibility.

3.14 FIELD QUALITY CONTROL

A. Sleeves and Sleeve Seals:

1. Perform the following tests and inspections:

a. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.
b. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.

2. Prepare test and inspection reports.

B. Escutcheons:

1. Using new materials, replace broken and damaged escutcheons and floor plates.

3.15 SLEEVES APPLICATION

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above and below Grade:

a. Sleeves with waterstops.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

2. Concrete Slabs-on-Grade:

a. Sleeves with waterstops.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

3. Concrete Slabs above Grade:

a. Sleeves with waterstops.

4. Interior Walls and Partitions:

a. Sleeves without waterstops.

3.16 THERMOMETER APPLICATION

A. Thermometers at inlet and outlet of each hydronic zone are to be the following:

1. Liquid-filled, bimetallic-actuated type.

B. Thermometers at inlet and outlet of each hydronic boiler are to be the following:

1. Liquid-filled, bimetallic-actuated type.
2. Test plug with EPDM self-sealing rubber inserts.

C. Thermometers at inlets and outlets of each chiller are to be the following:

1. Liquid-filled, bimetallic-actuated type.
2. Test plug with EPDM self-sealing rubber inserts.

D. Thermometers at inlet and outlet of each hydronic coil in air-handling units and built-up central systems are to be the following:

1. Liquid-filled, bimetallic-actuated type.
2. Test plug with EPDM self-sealing rubber inserts.

E. Thermometers at inlets and outlets of each hydronic heat exchanger are to be the following:

1. Liquid-filled, bimetallic-actuated type.
2. Test plug with EPDM self-sealing rubber inserts.

F. Thermometers at inlet and outlet of each hydronic heat-recovery unit are to be the following:

1. Liquid-filled, bimetallic-actuated type.
2. Test plug with EPDM self-sealing rubber inserts.

G. Thermometers at inlet and outlet of each thermal-storage tank are to be the following:

1. Liquid-filled, bimetallic-actuated type.
2. Test plug with EPDM self-sealing rubber inserts.

H. Thermometers at outside-, return-, supply-, and mixed-air ducts are to be the following:

1. Liquid-filled, bimetallic-actuated type.

I. Thermometer stems are to be of length to match thermowell insertion length.

3.17 THERMOMETER SCALE-RANGE APPLICATION

A. Scale Range for Heating, Hot-Water Piping:
1. 30 to 240 deg F.

B. Scale Range for Steam and Steam-Condensate Piping:
1. 50 to 400 deg F.

3.18 PRESSURE-GAUGE APPLICATION

A. Pressure gauges at discharge of each pressure-reducing valve are to be the following:

1. Liquid filled, mounted, metal case.
2. Test plug with EPDM self-sealing rubber inserts.

B. Pressure gauges at inlet and outlet of each chiller chilled-water and condenser-water connection are to be the following:

1. Liquid filled, direct mounted, metal case.
2. Test plug with EPDM self-sealing rubber inserts.

C. Pressure gauges at suction and discharge of each pump are to be the following:

1. Liquid-filled, direct mounted, metal case.
2. Test plug with EPDM self-sealing rubber inserts.

3.19 PRESSURE-GAUGE SCALE-RANGE APPLICATION

A. Scale range shall be twice the normal operating pressure of the measured system.

END OF SECTION 23 0500

SECTION 23 0523

GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Ball valves.
   2. Butterfly valves.
   3. Check valves.
   4. Gate valves.

1.2 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene-propylene-diene monomer.

C. FKM: Fluoroelastomer.

D. NBR: Nitrile butadiene rubber (also known as "Buna-N").

E. NRS: Nonrising stem.

F. OS&Y: Outside screw and yoke.

G. PTFE: Polytetrafluoroethylene.

H. RPTFE: Reinforced polytetrafluoroethylene.

I. RS: Rising stem.

J. SWP: Steam working pressure.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

   1. Include material descriptions and dimensions of individual components.
   2. Include operating characteristics and furnished accessories.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

   1. Protect internal parts against rust and corrosion.
   2. Protect threads, flange faces, grooved ends, press ends, solder ends, and weld ends.

3. Set ball valves open to minimize exposure of functional surfaces.
4. Set butterfly valves closed or slightly open.
5. Block check valves in either closed or open position.
6. Set gate valves closed to prevent rattling.
7. Set plug valves to open to minimize exposure of functional surfaces.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems or other components as lifting or rigging points unless specifically indicated for this purpose in manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain each type of valve from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. ASME Compliance:

1. ASME B1.20.1 for threads for threaded-end valves.
2. ASME B16.1 for flanges on iron valves.
3. ASME B16.5 for flanges on steel valves.
4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
5. ASME B16.18 for cast-copper solder-joint connections.
6. ASME B16.22 for wrought copper and copper-alloy solder-joint connections.
7. ASME B16.34 for flanged- and threaded-end connections.
8. ASME B16.51 for press joint connections.
9. ASME B31.1 for power piping valves.
10. ASME B31.9 for building services piping valves.

B. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.

C. Provide bronze valves made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are unacceptable.

D. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

E. Valve Sizes: Same as upstream piping unless otherwise indicated.

F. Valve Bypass and Drain Connections: MSS SP-45.

G. Wrench: Furnish Owner with one wrench for every five plug valves, for each size square plug-valve head.

H. Valve Actuator Type:

1. Gear Actuator: For quarter-turn ball valves NPS 4 and larger.
2. Hand Lever: For quarter-turn ball valves smaller than NPS 4.

I. Valves in Insulated Piping:

1. Provide 2-inch extended neck stems.
2. Provide extended operating handles with nonthermal-conductive covering material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
3. Provide memory stops that are fully adjustable after insulation is applied.

2.3 BALL VALVES

A. Ball Valves, Threaded or Soldered Ends - Brass, Two Piece with Full Port with Stainless-Steel Trim:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Conbraco Industries, Inc.; Apollo Valves
   b. Crane Co.; Crane Valve Group; Crane Valves
   c. Kitz Corporation.
   d. Watts Regulator co.; a division of Watts Water Technologies, Inc.
2. Description:
   a. Standard: MSS SP-110.
   b. SWP Rating: 150 psig.
   c. CWP Rating: 600 psig.
   d. Body Design: Two piece.
   e. Body Material: Forged brass.
   f. Ends: Soldered.
   g. Seats: PTFE or TFE.
   h. Stem: Stainless steel.
   i. Ball: Stainless steel.
   j. Port: Full.

B. Ball Valves, Threaded or Soldered Ends - Bronze, Two Piece with Full Port with Stainless-Steel Trim:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Conbraco Industries, Inc.; Apollo Valves
   b. Crane Co.; Crane Valve Group; Crane Valves
2. Description:
   a. Standard: MSS SP-110.
   b. SWP Rating: 150 psig.
   c. CWP Rating: 600 psig.
   d. Body Design: Two piece.
   e. Body Material: Bronze.
   f. Ends: Threaded.
   g. Seats: PTFE or TFE.
   h. Stem: Stainless steel.
   i. Ball: Stainless steel, vented.
   j. Port: Full.

2.4 BUTTERFLY VALVES

A. Butterfly Valves, Single Flange (Lug Type) - Iron, with EPDM Seat and Aluminum-Bronze Disc:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Kitz Corporation. Model 61122G.
      b. Milwaukee Valve Company.
      c. NIBCO Inc.
   2. Standard: MSS SP-67, Type I.
   3. CWP Rating: 200 psig.
   4. Body Design: Single flange (lug type), suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
   5. Body Material: ASTM A126, cast iron or ASTM A536, ductile iron.
   6. Seat: EPDM.
   7. Stem: One- or two-piece stainless steel.
   8. Disc: Aluminum bronze.

2.5 CHECK VALVES

A. Check Valves, Swing Type, Threaded Ends - Bronze, with Bronze Disc, Class 150:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Conbraco Industries, Inc.; Apollo Valves: Model 161 or approved equal.
   2. Standard: MSS SP-80, Type 3.
   3. CWP Rating: 200 psig.
   4. Body Design: Horizontal flow.
   5. Body Material: ASTM B62, bronze.
   6. Ends: Threaded.
   7. Disc: Bronze.

B. Check Valves, Swing Type, Flanged Ends - Iron, with Lever- and Spring-Closure Control, Class 125:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Conbraco Industries, Inc.; Apollo Valves: Model 910 or approved equal.
   2. Standard: MSS SP-71, Type I.
   3. CWP Rating, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): 200 psig.
   4. CWP Rating, NPS 14 to NPS 24 (DN 350 to DN 600): 150 psig.
   5. Body Design: Clear or full waterway.
   6. Body Material: ASTM A126, gray iron with bolted bonnet.
   7. Ends: Flanged.
   8. Trim: Bronze.
   9. Gasket: Asbestos free.

2.6 GATE VALVES

A. OS&Y, Iron Gate Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Kitz Corporation. Model 72.
   2. Standard: MSS SP-70, Type I.
   3. CWP Rating, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): 200 psig.
   4. CWP Rating, NPS 14 to NPS 24 (DN 350 to DN 600): 150 psig.
   5. Body Material: ASTM A 126, gray iron with bolted bonnet.

6. Ends: Flanged
7. Trim: Bronze.
8. Disc: Solid Wedge.
9. Packing and Gasket: Asbestos free.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Examine press fittings to verify they have been properly pressed.

F. Do not attempt to repair defective valves; replace with new valves. Remove defective valves from site.

3.2 INSTALLATION OF VALVES

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Provide support of piping adjacent to valves such that no force is imposed upon valves.

C. Locate valves for easy access and where not blocked by equipment, other piping, or building components.

D. For valves in horizontal piping, install valves with stem at or above center of pipe.

E. Install valves in position that does not project into aisles or block access to other equipment.

F. Install valves in position to allow full stem and actuator or manual operator movement.

G. Verify that joints of each valve have been properly installed and sealed to ensure that there is no leakage or damage.

H. Chainwheels: Install chainwheels on manual operators for globe butterfly gate and plug valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.

I. Install check valves for proper direction of flow and as follows:
   1. Check Valves, Swing Type: In horizontal position with hinge pin level.

J. Valve Tags: Comply with requirements for valve tags and schedules in Section 230553 "Identification for HVAC Piping and Equipment."

K. Adhere to manufacturer's written installation instructions. When soldering or brazing valves, do not heat valves above maximum permitted temperature. Do not use solder with melting point temperature above valve of manufacturer's written recommended maximum.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service, but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:
   1. Shutoff Service: Ball, butterfly, or gate valves.
   2. Throttling Service, Except Steam: Globe or ball valves.
   3. Pump-Discharge Check Valves:
      a. DN 50 NPS 2 and Smaller: Bronze swing check valves with bronze or nonmetallic disc.
      b. DN 65 NPS 2-1/2 and Larger: Iron swing check valves with lever and weight or with spring.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:
   1. For Copper Tubing, DN 50 NPS 2 and Smaller: Threaded ends except where solder-joint valve- end option is indicated in valve schedules below.
   2. For Copper Tubing, DN 65 to DN 100 NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
   3. For Copper Tubing, DN 125 NPS 5 and Larger: Flanged ends.
   4. For Steel Piping, DN 50 NPS 2 and Smaller: Threaded ends.
   5. For Steel Piping, DN 65 to DN 100 NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
   6. For Steel Piping, DN 125 NPS 5 and Larger: Flanged ends.

3.5 HEATING-WATER & CORE LOOP VALVE SCHEDULE

A. Heating/Boiler Contractor shall furnish and installed valves.

B. Pipe NPS 3 (DN 80) and Smaller:
   1. Bronze Ball Valves.
   2. Bronze Swing Check Valves.
   3. Bronze Globe Valves.

C. Pipe NPS 3-1/2 (DN 90) and Larger:
   1. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): May be provided with threaded ends instead of flanged ends.
   2. Iron, Single-Flange Butterfly Valves.
   3. Iron Swing Check Valves.
   4. Iron Gate Valves.

3.6 VALVE LABELING

A. All valves installed in building shall be provided with a metal tag with number stamped on tag & tag wired to handle on valve. A typed register framed and under a glass cover shall be mounted on a wall in boiler room for easy reading. Register shall have valves numerically indicating location of each valve and description of control purpose of valve. Valve tags shall be color coded by adhesive backed labels.

B. All control valves not immediately in sight of fixtures and equipment controlled shall be provided with approved metal tags on which shall be stamped identifying description of equipment or piping controlled. Valve tags shall be color coded by adhesive backed labels.

END OF SECTION 23 0523

SECTION 23 0529

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe hangers and supports - metal.
2. Pipe hangers - metal, trapeze type.
3. Strut support systems - metal, rod type.
4. Strut support systems - rooftop mounted.
5. Thermal-hanger shield inserts.
6. Fastener systems.
7. Equipment supports.
8. Equipment stands - outdoor type.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 23 "Metal Ducts" and “Nonmetal Ducts” for duct hangers and supports.

1.2 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers.
2. Metal strut support systems.
3. Rooftop-mounted strut support systems.
4. FRP strut support systems.
5. Pipe stands.
6. Equipment supports.

C. Delegated Design Submittals: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication/assembly and design calculations for trapeze hangers.
2. Detail fabrication/assembly and design calculations for each type of strut support system, by the manufacturer's technical representative.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.4 QUALITY ASSURANCE

A. Structural-Steel Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators in accordance with 2021 ASME Boiler and Pressure Vessel Code, Section IX.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design trapeze pipe hangers and equipment supports.

B. Structural Performance: Hangers and supports for HVAC piping and equipment are to withstand the effects of gravity loads and stresses within limits and under conditions indicated in accordance with ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
3. Design seismic-restraint hangers and supports for piping and equipment.

2.2 PIPE HANGERS AND SUPPORTS - METAL

A. Pipe Hangers and Supports - Carbon Steel:
1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized, hot-dip galvanized, or electro-galvanized.
3. Nonmetallic Coatings: Plastic coated, or epoxy powder coated.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washers made of carbon steel.

2.3 PIPE HANGERS - METAL, TRAPEZE TYPE

A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.4 STRUT SUPPORT SYSTEMS - METAL, ROD TYPE

A. Description: Factory-fabricated pipe-support assembly made of steel channels, vertical metal support rods, accessories, fittings, and other components for supporting multiple parallel pipes.

B. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.

C. Struts: Continuous slotted carbon-steel channel with inturned lips or angle.

D. Strut Width: Selected for applicable load criteria.

E. Strut Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.

F. Hanger Rods: Continuous-thread rod, nuts, and washer made of galvanized steel.

G. Metallic Coating: Electroplated zinc.

H. Paint Coating: Green epoxy, acrylic, or urethane.

2.5 STRUT SUPPORT SYSTEMS - FRP

A. Description: Structural-grade, factory-formed, glass-fiber-resin channels and angles for supporting multiple parallel pipes.

1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
2. Struts: Continuous slotted fiberglass-reinforced plastic channel with inturned lips.
3. Strut Width: Selected for applicable load criteria.
4. Fittings and Accessories: Products provided by channel and angle manufacturer and designed for use with those items.
5. Fitting and Accessory Materials: Same as those for channels and angles, except metal items may be stainless steel.
6. Rated Strength: Selected to suit applicable load criteria.
7. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

2.6 STRUT SUPPORT SYSTEMS - ROOFTOP MOUNTED

A. General Requirements: Shop-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Pipe Stand - Compact:
1. Description: Single base unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
3. Hardware: Galvanized steel or polycarbonate.
4. Accessories: Protection pads.

C. Pipe Stand - Single Base, Single Pipe, Low Profile:
1. Description: Single base with vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
3. Vertical Members: Two, [**galvanized-steel**] [**stainless steel**], continuous-thread 1/2-inch rods.
4. Horizontal Member: Adjustable-height, [**galvanized-steel**] [**stainless steel**] pipe support channels.
5. Pipe Supports: Roller.
6. Hardware: Galvanized steel.

7. Accessories: Protection pads.
8. Height: 12 inches above roof.

D. Pipe Stand - Single Base, Single Pipe, High Profile:
1. Description: Single base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
2. Base: Single vulcanized rubber or molded polypropylene.
3. Vertical Members: Two, galvanized-steel, continuous-thread 1/2-inch rods.
4. Horizontal Member: One, adjustable-height, galvanized-steel pipe support slotted channel or plate.
5. Pipe Supports: Roller.
6. Hardware: Galvanized steel.
7. Accessories: Protection pads, 1/2-inch continuous-thread galvanized-steel rod.
8. Height: 36 inches above roof.

E. Pipe Stand - Multiple Pipe, High Profile:
1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
2. Bases: Two or more; vulcanized rubber.
3. Vertical Members: Two or more, galvanized-steel channels.
4. Horizontal Members: One or more, adjustable-height, galvanized-steel pipe support.
5. Pipe Supports: Roller Strut clamps Clevis hanger Swivel hanger.
6. Hardware: Galvanized steel.
7. Accessories: Protection pads, 1/2-inch continuous-thread rod.
8. Height: 36 inches above roof.

F. Pipe Stand - Curb-Mounted Type: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.7 THERMAL-HANGER SHIELD INSERTS

A. Insulation-Insert Material for Cold Piping: ASTM C591, Type VI, Grade 1 polyisocyanurate with 125 psi minimum compressive strength and vapor barrier.

B. Insulation-Insert Material for Hot Piping: Water-repellent-treated, ASTM C533, Type I calcium silicate with 100 psi minimum compressive strength.

C. For Trapeze or Clamped Systems: Insert and shield are to cover entire circumference of pipe.

D. For Clevis or Band Hangers: Insert and shield are to cover bottom 180 degrees of pipe.

E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.8 FASTENER SYSTEMS

A. Fastener System - Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities required for supported loads and building materials where used.

B. Fastener System - Mechanical-Expansion Anchors: Insert-wedge-type anchors for use in hardened portland cement concrete; with pull-out, tension, and shear capacities required for supported loads and building materials where used.
   1. Indoor Applications: Zinc-plated steel.
   2. Outdoor Applications: Stainless steel.

2.9 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.10 EQUIPMENT STANDS, OUTDOOR TYPE

A. Description: Individual foot supports with elevated adjustable channel cross bars and clamps/fasteners/bolts for ground- or roof-supported outdoor equipment components, without roof membrane penetration, in a prefabricated system that can be modularly-assembled on site.

B. Foot Material: Rubber or polypropylene.

C. Rails Material: Hot dip galvanized carbon steel.

2.11 MATERIALS

A. Aluminum: ASTM B221.

B. Carbon Steel: ASTM A1011/A1011M.

C. Structural Steel: ASTM A36/A36M, carbon-steel plates, shapes, and bars; galvanized.

D. Stainless Steel: ASTM A240/A240M.

E. Threaded Rods: Continuously threaded. Zinc-plated or galvanized steel for indoor applications and stainless steel for outdoor applications. Mating nuts and washers of similar materials as rods.

F. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

   1. Properties: Nonstaining, noncorrosive, and nongaseous.
   2. Design Mix: 5000 psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry static loads within specified loading limits. Minimum static design load used for strength determination is to include weight of supported components plus 200 lb.

3.2 INSTALLATION OF HANGERS AND SUPPORTS

A. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

B. Install lateral bracing with pipe hangers and supports to prevent swaying.

C. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Coordinate location of concrete inserts before concrete is placed.

D. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

E. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

F. Insulated Piping:

1. Attach clamps and spacers to piping.

    a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

    a. Thermal-hanger shield inserts may be used as an option. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields are to span an arc of 180 degrees.

    a. Thermal-hanger shield inserts may be used as an option. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

    a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches long and 0.048 inch thick.
    b. NPS 4 (DN 100): 12 inches long and 0.06 inch thick.
    c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches long and 0.06 inch thick.
    d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches long and 0.075 inch thick.
    e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches long and 0.105 inch thick.

5. Pipes NPS 8 (DN 200) and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.

G. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

H. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size, or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
2. Field fabricate in accordance with ASTM A36/A36M, carbon-steel shapes selected for loads being supported. Weld steel in accordance with AWS D1.1/D1.1M.

I. FRP Pipe-Hanger Installation: Comply with applicable portions of MSS SP-58. Install hangers and attachments as required to properly support piping from building structure.

J. Strut System Installation: Metal. Arrange for grouping of parallel runs of piping, and support together on field-assembled strut systems.

K. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

L. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick after concrete is placed and cured. Use installers that are licensed by powder-actuated tool manufacturer.
2. Install mechanical-expansion anchors after concrete is placed and completely cured.
3. Install fasteners in accordance with manufacturer's written instructions.
4. Install lag screw wood fasteners in accordance with manufacturer's written instructions.

M. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for curbs.

N. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

O. Equipment Support Installation:

1. Fabricate from welded-structural-steel shapes.
2. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
3. Grouting: Place grout under supports for floor-mounted equipment, and make bearing surface smooth.
4. Provide lateral bracing, to prevent swaying.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

A. Touchup:

1. Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

    a. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

2. Comply with requirements in Section 099113 "Exterior Painting" Section 099123 "Interior Painting" and Section 099600 "High-Performance Coatings" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
3. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780/A780M.

3.6 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports metal trapeze pipe hangers and metal framing systems and attachments for general service applications.

F. Use stainless steel pipe hangers FRP pipe hangers and FRP strut systems and stainless steel or corrosion-resistant attachments for hostile environment applications.

G. Use padded hangers for piping that is subject to scratching.

H. Use thermal-hanger shield inserts for insulated piping and tubing.

I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.

18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is unnecessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is unnecessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

a. Light (MSS Type 31): 750 lb.
b. Medium (MSS Type 32): 1500 lb.
c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

a. Horizontal (MSS Type 54): Mounted horizontally.
b. Vertical (MSS Type 55): Mounted vertically.
c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

O. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

P. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 23 0529

SECTION 23 0548

VIBRATION AND SEISMIC CONTROLS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Elastomeric isolation pads.
2. Elastomeric isolation mounts.
3. Restrained elastomeric isolation mounts.
4. Open-spring isolators.
5. Housed-spring isolators.
6. Restrained-spring isolators.
7. Housed-restrained-spring isolators.
8. Pipe-riser resilient support.
9. Resilient pipe guides.
10. Air-spring isolators.
11. Restrained-air-spring isolators.
12. Elastomeric hangers.
13. Spring hangers.
14. Snubbers.
15. Restraints - rigid type.
16. Restraints - cable type.
17. Restraint accessories.
18. Post-installed concrete anchors.
19. Concrete inserts.
20. Vibration isolation equipment bases.
21. Seismically restrained isolation roof-curb rails.

B. Related Requirements:

1. Section 018123 "Facility Seismic and Wind Criteria" specifies basis-of-design seismic and wind criteria for nonstructural components.
2. Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment" specifies devices for fire-suppression equipment and systems.
3. Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" specifies devices for plumbing equipment and systems.

1.2 DEFINITIONS

A. Designated Seismic System: An architectural, mechanical, electrical, plumbing, or fire protection system and its components for which the component importance factor is greater than 1.0 when determined in accordance with Section 018123 "Facility Seismic and Wind Criteria."

B. IBC: International Building Code.

C. OSHPD: Office of Statewide Health Planning and Development (for the State of California owned and regulated medical facilities).

1.3 DELEGATED DESIGN SERVICES

A. Delegated Design Professional: Engage qualified professional structural engineer to design seismic and wind restraints.

1.4 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.

    a. Include rated load, rated deflection, and overload capacity for each vibration isolation device.

2. Include load rating for each seismic-restraint device.
3. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device and seismic-restraint component.
4. Annotate types and sizes of seismic restraints and accessories, complete with listing markings or report numbers and load rating in tension and compression as evaluated by ICC-ES product listing.
5. Annotate to indicate application of each product submitted and compliance with requirements.
6. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Shop Drawings:

1. Detail fabrication and assembly of equipment bases.
2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
3. Show coordination of seismic restraints for components with other systems and equipment in the vicinity, including other supports and other seismic restraints.

C. Delegated Design Submittals:

1. All delegated design and submittals for seismic restraints must be signed and sealed by a qualified professional structural engineer responsible for their preparation. Structural engineer is to possess qualifications specified in Section 014000 "Quality Requirements," with expertise in structural engineering, including design of seismic and wind restraints, equipment hangers and supports, and concrete attachments.
2. For each seismic-restraint device, including seismic-restrained mounting, pipe-riser resilient support, snubber, seismic restraint, seismic-restraint accessory, concrete anchor and insert, and restrained isolation roof-curb rail that is required by this Section or is indicated on Drawings, submit the following:

    a. Seismic Restraint, Vibration Isolator, and Vibration Isolation Base Selection: Select and submit seismic restraints and vibration isolators, and vibration isolation bases complying with performance requirements, design criteria, and analysis data.
    b. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification by professional engineer that riser system was examined for excessive stress and that none exists.

c. Post-Installed Concrete Anchors and Concrete Inserts: Include calculations showing anticipated seismic loads. Include certification that device is approved by an NRTL for reinforcement use.
d. Seismic Design Calculations: Submit all input data and loading calculations.

3. Seismic- and Wind-Restraint Detail Drawing:

a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply also with requirements in other Sections for equipment mounted outdoors.

4. Product Listing, Preapproval, and Evaluation Documentation: By an evaluation service member of ICC-ES, showing maximum ratings of restraint items and basis for approval (tests or calculations).
5. Design Calculations for Vibration Isolation Devices: Calculate static and dynamic loading due to equipment weight and operating forces required to select proper vibration isolators, and to design vibration isolation bases.
6. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, and spring deflection changes. Include certification that riser system was examined for excessive stress and that none exists.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of vibration isolation and seismic-restraint devices for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.

B. Qualification Data: For professional engineer.

C. Welding certificates.

D. Field quality-control reports.

1.6 REGULATORY AGENCY APPROVALS

A. Delegated design submittals and Shop Drawings requiring approval by authorities having jurisdiction must be signed by qualified structural professional engineer responsible for their preparation. Submit for action by Architect prior to submitting for approval by authorities having jurisdiction.

1.7 QUALIFICATIONS

A. Professional Structural Engineer: Professional engineer possessing active qualifications specified in Section 014000 "Quality Requirements," with expertise in structural engineering,

including design of seismic and wind restraints, equipment hangers and supports, and concrete foundations.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7 and that is acceptable to authorities having jurisdiction.

B. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage qualified professional structural engineer to prepare seismic- and wind-restraint calculations in accordance with criteria specified in Section 018123 "Facility Seismic and Wind Criteria."

B. Seismic- and Wind-Restraint-Device Load Ratings: Devices are to be tested and rated in accordance with applicable code requirements and authorities having jurisdiction. Devices are to be listed by a nationally recognized third party that requires periodic follow-up inspections and has a listing directory available to the public. Provide third-party listing by one or more of the following: ICC-ES product listing.

C. Consequential Damage: Provide additional seismic restraints for suspended components or anchorage of floor-, roof-, or wall-mounted components so that failure of a non-essential or essential component will not cause failure of any other essential building component.

D. Fire/Smoke Resistance: Seismic- and wind-restraint devices that are not constructed of ferrous metals are to have a maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested by qualified testing laboratory in accordance with ASTM E84 or UL 723 and be labeled as such.

E. Component Supports:

1. Load ratings, features, and applications of reinforcement components are to be based on testing standards of qualified testing laboratory.

2.2 ELASTOMERIC ISOLATION PADS

A. Elastomeric Isolation Pads:
1. Source Limitations: Obtain elastomeric isolation pads from single manufacturer.
2. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
3. Size: Factory or field cut to match requirements of supported equipment.
4. Pad Material: Oil and water resistant with elastomeric properties. Neoprene rubber, silicone rubber, or other elastomeric material.
5. Surface Pattern: Smooth, ribbed, or waffle pattern.
6. Infused nonwoven cotton or synthetic fibers.

7. Load-bearing metal plates adhered to pads.
8. Sandwich-Core Material: Resilient and elastomeric.

    a. Surface Pattern: Smooth, ribbed, or waffle pattern.
    b. Infused nonwoven cotton or synthetic fibers.

2.3 ELASTOMERIC ISOLATION MOUNTS

A. Double-Deflection, Elastomeric Isolation Mounts:
1. Source Limitations: Obtain double-deflection, elastomeric isolation mounts from single manufacturer.
2. Mounting Plates:

    a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded with threaded studs or bolts.
    b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.

3. Elastomeric Material: Molded, oil- and water- resistant neoprene rubber, silicone rubber, or other elastomeric material.

2.4 RESTRAINED ELASTOMERIC ISOLATION MOUNTS

A. Restrained Elastomeric Isolation Mounts:
1. Source Limitations: Obtain restrained elastomeric isolation mounts from single manufacturer.
2. Description: All-directional isolator with seismic restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.

    a. Housing: Cast-ductile iron or welded steel.
    b. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.5 OPEN-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators:
1. Source Limitations: Obtain freestanding, laterally stable, open-spring isolators from single manufacturer.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Baseplates: Factory-drilled steel plate for bolting to structure with an elastomeric isolator pad attached to the underside. Baseplates limit floor load to 500 psig.
7. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

2.6 HOUSED-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators in Two-Part Telescoping Housing:
   1. Source Limitations: Obtain freestanding, laterally stable, open-spring isolators in two-part telescoping housing from single manufacturer.
   2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
   3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
   4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
   5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
   6. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators.

      a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases limit floor load to 500 psig.
      b. Top housing with attachment and leveling bolt.

2.7 RESTRAINED-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint:
   1. Source Limitations: Obtain restrained-spring isolators from single manufacturer.
   2. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.

      a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases limit floor load to 500 psig.
      b. Top plate with threaded mounting holes.
      c. Internal leveling bolt that acts as blocking during installation.

   3. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
   4. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
   5. Minimum Additional Travel: 50 percent of the required deflection at rated load.
   6. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
   7. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.8 HOUSED-RESTRAINED-SPRING ISOLATORS

A. Freestanding, Steel, Open-Spring Isolators with Vertical-Limit Stop Restraint in Two-Part Telescoping Housing:
   1. Source Limitations: Obtain freestanding, open-spring isolators with vertical-limit stop restraints from single manufacturer.
   2. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators. Housings are equipped with adjustable snubbers to limit vertical movement.

      a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases limit floor load to 500 psig.
      b. Threaded top housing with adjustment bolt and cap screw to fasten and level equipment.

3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.9 PIPE-RISER RESILIENT SUPPORT

A. All-Directional, Acoustical Pipe Anchor Consisting of Two Steel Tubes Separated by a Minimum 1/2-Inch- (13-mm-) Thick Neoprene:
   1. Source Limitations: Obtain resilient pipe-riser supports from single manufacturer.
   2. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum 1/2-inch-thick neoprene.
   3. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
   4. Maximum Load Per Support: 500 psig on isolation material providing equal isolation in all directions.

2.10 RESILIENT PIPE GUIDES

A. Telescopic Arrangement of Two Steel Tubes or Post and Sleeve Arrangement Separated by a Minimum 1/2-Inch- (13-mm-) Thick Neoprene:
   1. Source Limitations: Obtain resilient pipe guides from single manufacturer.
   2. Description: Resilient pipe guide with telescopic arrangement of two steel tubes or post and sleeve arrangement separated by a minimum 1/2-inch-thick neoprene.
   3. Factory-Set Height Guide with Shear Pin: Shear pin to be removable and reinsertable to allow for selection of pipe movement. Guides to be capable of motion to meet location requirements.

2.11 ELASTOMERIC HANGERS

A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods:
   1. Source Limitations: Obtain elastomeric hangers from a single manufacturer.
   2. Description: Elastomeric hanger mounted in a steel frame with upper and lower steel hanger rods.
   3. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
   4. Damping Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

2.12 SPRING HANGERS

A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression:
   1. Source Limitations: Obtain spring hangers from single manufacturer.
   2. Description: Combination coil-spring and elastomeric-insert hanger.
   3. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.

4. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
5. Minimum Additional Travel: 50 percent of the required deflection at rated load.
6. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
7. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
8. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
9. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
10. Self-centering hanger-rod cap to ensure concentricity between hanger rod and support spring coil.

2.13 SNUBBERS

A. Source Limitations: Obtain snubbers from single manufacturer.

B. Description: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.

1. Post-Installed Concrete Anchor Bolts: Secure to concrete surface with post-installed concrete anchors. Anchors to be seismically prequalified in accordance with ACI 355.2 testing and designated in accordance with ACI 318-14, Ch. 17 for 2015 or 2018 IBC.
2. Preset Concrete Inserts: Seismically prequalified in accordance with ICC-ES AC446 testing.
3. Anchors in Masonry: Design in accordance with TMS 402.
4. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
5. Resilient Cushion: Maximum 1/4-inch air gap, and minimum 1/4 inch thick.

2.14 RESTRAINTS - RIGID TYPE

A. Source Limitations: Obtain rigid-type restraints from single manufacturer.

B. Description: Shop- or field-fabricated bracing assembly made of AISI S110-07-S1 slotted steel channels, ANSI/ASTM A53/A53M steel pipe as per NFPA 13, or other rigid steel brace member. Includes accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.15 RESTRAINTS - CABLE TYPE

A. Source Limitations: Obtain cable-type restraints from single manufacturer.

B. Seismic- and Wind-Restraint Cables: ASTM A1023/A1023M galvanized or ASTM A603 galvanized-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for seismic-restraining cable service; with fittings attached by means of poured socket, swaged socket or mechanical (Flemish eye) loop.

C. Restraint cable assembly with cable fittings must comply with ASCE/SEI 19. All cable fittings and complete cable assembly must maintain the minimum cable breaking force. U-shaped cable clips and wedge-type end fittings do not comply and are unacceptable.

2.16 RESTRAINT ACCESSORIES

A. Source Limitations: Obtain restraint accessories from single manufacturer.

B. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod. Non-metallic stiffeners are unacceptable.

C. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.

D. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings and matched to type and size of anchor bolts and studs.

E. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings and matched to type and size of attachment devices used.

F. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.17 POST-INSTALLED CONCRETE ANCHORS

A. Mechanical Anchor Bolts:
   1. Source Limitations: Obtain mechanical anchor bolts from single manufacturer.
   2. Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength for anchor and as tested according to ASTM E488/E488M.

B. Adhesive Anchor Bolts:
   1. Source Limitations: Obtain adhesive anchor bolts from single manufacturer.
   2. Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488/E488M.

C. Expansion-type anchor bolts are not permitted for equipment in excess of 10 hp that is not vibration isolated.

   1. Undercut expansion anchors are permitted.

2.18 CONCRETE INSERTS

A. Source Limitations: Obtain concrete inserts from single manufacturer.

B. Provide preset concrete inserts that are seismically prequalified in accordance with ICC-ES AC466 testing.

C. Comply with ANSI/MSS SP-58.

2.19 VIBRATION ISOLATION EQUIPMENT BASES

A. Source Limitations: Obtain vibration isolation equipment bases from single manufacturer.

B. Steel Rails: Factory-fabricated, welded, structural-steel rails.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide rails.

    a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A36/A36M. Rails to have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

C. Steel Bases: Factory-fabricated, welded, structural-steel bases and rails.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

    a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A36/A36M. Bases to have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

D. Concrete Inertia Base: Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

    a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A36/A36M. Bases to have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

2.20 SEISMICALLY RESTRAINED ISOLATION ROOF-CURB RAILS

A. Seismically Restrained Isolation Roof-Curb Rails:
1. Source Limitations: Obtain restrained isolation roof-curb rails from single manufacturer.
2. Description: Factory-assembled, fully enclosed, insulated, air- and watertight curb rail designed to resiliently support equipment and to withstand seismic forces.
3. Upper Frame: To provide continuous support for equipment and to be captive to resiliently resist seismic forces.

4. Lower Support Assembly: To be formed sheet metal section containing adjustable and removable steel springs that support the upper frame. Lower support assembly to have a means for attaching to building structure and a wood nailer for attaching roof materials, and to be insulated with a minimum of 2 inches of rigid, glass-fiber insulation on inside of assembly. Mount adjustable, restrained-spring isolators on elastomeric vibration isolation pads and provide access ports, for level adjustment, with removable waterproof covers at all isolator locations. Locate isolators so they are accessible for adjustment at any time during the life of the installation without interfering with integrity of roof.
5. Snubber Bushings: All-directional, elastomeric snubber bushings at least 1/4 inch thick.
6. Water Seal: Galvanized sheet metal with EPDM seals at corners, attached to upper support frame, extending down past wood nailer of lower support assembly, and counterflashed over roof materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-restraint devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an evaluation service member of ICC-ES.

B. Hanger-Rod Stiffeners: Install where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Assemblies: Where not specifically indicated otherwise, select sizes of components so strength is adequate to carry static and seismic loads within specified loading limits.

3.3 INSTALLATION OF VIBRATION CONTROLS AND SEISMIC RESTRAINTS FOR HVAC PIPING AND EQUIPMENT

A. Provide seismic-restraint devices and vibration-control devices for systems and equipment where indicated in Equipment Schedules or Vibration-Control Devices Schedules, where indicated on Drawings, or where Specifications indicate they are to be installed on specific equipment and systems.

B. Provide seismic-restraintdevices for systems and equipment where indicated in Equipment Schedules or Seismic-Restraint Devices Schedules, where indicated on Drawings, where Specifications indicate they are to be installed on specific equipment and systems, and where required by applicable codes.

C. Coordinate location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."

D. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

E. Comply with requirements in Section 077200 "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.

F. Equipment Restraints:

1. Install snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
3. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES that provides required submittals for component.

G. Piping Restraints:

1. Comply with requirements in MSS SP-127.
2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
3. Brace a change of direction longer than 12 feet.

H. Ductwork Restraints:

1. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."
2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
3. Brace a change of direction longer than 12 feet.
4. Select seismic-restraint devices with capacities adequate to carry static and seismic loads.
5. Install cable restraints on ducts that are suspended with vibration isolators.

I. Install seismic-restraint cables so they do not bend across edges of adjacent equipment or building structure.

J. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES that provides required submittals for component.

K. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

L. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

M. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

N. Post-Installed Concrete Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Mechanical Anchor Bolts: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors to be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchor Bolts: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless steel anchors for exterior applications.

3.4 INSTALLATION OF AIR-SPRING ISOLATORS

A. Independent Isolator Installation:

1. Install tank valve into each air isolator.
2. Inflate each isolator to height and pressure specified on Drawings.

B. Pressure-Regulated Isolator Installation:

1. Coordinate the constant pressure-regulated air supply to air springs with requirements for piping and connections specified in Section 221513 "General-Service Compressed-Air Piping."
2. Connect all pressure regulators to a single dry, filtered constant air supply.
3. Inflate isolators to height and or pressure specified on Drawings.

3.5 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Provide flexible connections in piping systems where they cross structural seismic joints and other point where differential movement may occur. Provide adequate flexibility to accommodate differential movement as determined in accordance with ASCE/SEI 7. Comply with requirements in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties" for piping flexible connections.

3.6 INSTALLATION OF VIBRATION ISOLATION EQUIPMENT BASES

A. Coordinate location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."

B. Coordinate dimensions of steel equipment rails and bases, concrete inertia bases, and restrained isolation roof-curb rails with requirements of isolated equipment specified in this and other Sections. Where dimensions of these bases are indicated on Drawings, dimensions may require adjustment to accommodate actual isolated equipment.

3.7 ADJUSTING

A. Adjust isolators after system is at operating weight.

B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Tests and Inspections:

1. Perform tests and inspections with the assistance of a factory-authorized service representative.
2. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
3. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
4. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
5. Test no fewer than four of each type and size of installed anchors and fasteners selected by Architect.
6. Test to 90 percent of rated proof load of device.
7. Measure isolator restraint clearance.
8. Measure isolator deflection.
9. Verify snubber minimum clearances.
10. Test and adjust restrained-air-spring isolator controls and safeties.

D. Remove and replace malfunctioning units and retest as specified above.

E. Units will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

END OF SECTION 23 0548

SECTION 23 0553

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Pipe labels.
3. Stencils.
4. Valve tags.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment-Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve-numbering scheme.

E. Valve Schedules: For each piping system. Include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Outdoor Equipment:
1. Lettering: Stenciled.
2. Minimum Letter Size: 4-inch

B. Plastic Labels for Indoor Equipment:
1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, with predrilled holes for attachment hardware.
2. Letter and Background Color: As indicated for specific application under Part 3.
3. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.
4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
6. Fasteners: Stainless steel rivets or self-tapping screws.

7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

2.2 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color coded, with lettering indicating service and showing flow direction in accordance with ASME A13.1.

B. Letter and Background Color: As indicated for specific application under Part 3.

C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.

D. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

E. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings. Also include:

1. Pipe size.
2. Flow-Direction Arrows: Include flow-direction arrows on main distribution piping. Arrows may be either integral with label or applied separately.
3. Lettering Size: Size letters in accordance with ASME A13.1 for piping.

2.3 STENCILS

A. Stencils for Piping:
1. Lettering Size: Size letters in accordance with ASME A13.1 for piping if not indicated.
2. Stencil Material: Aluminum, brass, or fiberboard.
3. Stencil Paint: Exterior, gloss, alkyd enamel in colors complying with recommendations in ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.
4. Identification Paint: Exterior, alkyd enamel in colors in accordance with ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.
5. Letter and Background Color: As indicated for specific application under Part 3.

2.4 VALVE TAGS

A. Description: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.04-inch minimum thickness, with predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire link chain or beaded chain or S-hook.

B. Letter and Background Color: As indicated for specific application under Part 3.

C. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Include valve-tag schedule in operation and maintenance data.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

3.2 INSTALLATION, GENERAL REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

D. Locate identifying devices so that they are readily visible from the point of normal approach.

3.3 INSTALLATION OF EQUIPMENT LABELS, WARNING SIGNS, AND LABELS

A. Permanently fasten labels on each item of plumbing equipment.

B. Locate equipment labels where accessible and visible.

3.4 INSTALLATION OF PIPE LABELS

A. Install pipe labels showing service and flow direction with permanent adhesive on pipes.

B. Stenciled Pipe Label Option: Stenciled labels showing service and flow direction may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, with painted, color-coded bands or rectangles on each piping system.

1. Identification Paint: Use for contrasting background.
2. Stencil Paint: Use for pipe marking.

C. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Within 3 ft. of each valve and control device.
2. At access doors, manholes, and similar access points that permit view of concealed piping.
3. Within 3 ft. of equipment items and other points of origination and termination.
4. Spaced at maximum intervals of 25 ft. along each run. Reduce intervals to 10 ft. in areas of congested piping and equipment.

D. Do not apply plastic pipe labels or plastic tapes directly to bare pipes conveying fluids at temperatures of 125 deg F or higher. Where these pipes are to remain uninsulated, use a short section of insulation or use stenciled labels.

E. Flow-Direction Flow Arrows: Use arrows, in compliance with ASME A13.1, to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

F. Pipe-Label Color Schedule:
   1. Domestic Cold-Water Piping (Cold, Hot, Recirculating, Non-Potable, Irrigation):
      a. Background Color: White
      b. Letter Color: Black
   2. Natural Gas Piping:
      a. Background Color: White
      b. Letter Color: Black
   3. Heating Water Piping:
      a. Background Color: Yellow
      b. Letter Color: Black
   4. Core Loop Piping:
      a. Background Color: Yellow
      b. Letter Color: Black
   5. Low-Pressure Steam Piping:
      a. Background Color: White
      b. Letter Color: Black

3.5 INSTALLATION OF VALVE TAGS

A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule in the operating and maintenance manual.

   1. Valve-Tag Colors:

      a. For each piping system, use the same lettering and background coloring system on valve tags as used in the piping system labels and background.

END OF SECTION 23 0553

SECTION 23 0593

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Testing, Adjusting, and Balancing of Air Systems:

    a. Constant-volume air systems.
    b. Variable-air-volume systems.

2. Testing, Adjusting, and Balancing of Hydronic Piping Systems:

    a. Constant-flow hydronic systems.
    b. Variable-flow hydronic systems.
    c. Domestic hot water circulating systems.

1.3 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. NEBB: National Environmental Balancing Bureau.

C. TAB: Testing, adjusting, and balancing.

D. TABB: Testing, Adjusting, and Balancing Bureau.

E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.

F. TDH: Total dynamic head.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Certified TAB reports.

C. Sample report forms.

D. Instrument calibration reports, to include the following:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.5 QUALITY ASSURANCE

A. TAB Specialists Qualifications, Certified by NEBB or AABC:

1. TAB Field Supervisor: Employee of the TAB specialist and certified by NEBB or AABC.
2. TAB Technician: Employee of the TAB specialist and certified by NEBB or AABC.

B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

C. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.7.2.3 - "System Balancing."

D. Code and AHJ Compliance: TAB is required to comply with governing codes and requirements of authorities having jurisdiction.

1.6 FIELD CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.

B. Examine installed systems for balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine ceiling plenums and underfloor air plenums used for HVAC to verify that they are properly separated from adjacent areas and sealed.

F. Examine equipment performance data, including fan and pump curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

H. Examine test reports specified in individual system and equipment Sections.

I. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.

J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

K. Examine temporary and permanent strainers. Verify that temporary strainer screens used during system cleaning and flushing have been removed and permanent strainer baskets are installed and clean.

L. Examine control valves for proper installation for their intended function of isolating, throttling, diverting, or mixing fluid flows.

M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

N. Examine system pumps to ensure absence of entrained air in the suction piping.

O. Examine operating safety interlocks and controls on HVAC equipment.

P. Examine control dampers for proper installation for their intended function of isolating, throttling, diverting, or mixing air flows.

Q. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes the following:

1. Equipment and systems to be tested.

2. Strategies and step-by-step procedures for balancing the systems.
3. Instrumentation to be used.
4. Sample forms with specific identification for all equipment.

B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:

1. Airside:

a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
b. Duct systems are complete with terminals installed.
c. Volume, smoke, and fire dampers are open and functional.
d. Clean filters are installed.
e. Fans are operating, free of vibration, and rotating in correct direction.
f. Variable-frequency controllers' startup is complete and safeties are verified.
g. Automatic temperature-control systems are operational.
h. Ceilings are installed.
i. Windows and doors are installed.
j. Suitable access to balancing devices and equipment is provided.

2. Hydronics:

a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed.
b. Piping is complete with terminals installed.
c. Water treatment is complete.
d. Systems are flushed, filled, and air purged.
e. Strainers are pulled and cleaned.
f. Control valves are functioning in accordance with the sequence of operation.
g. Shutoff and balance valves have been verified to be 100 percent open.
h. Pumps are started and proper rotation is verified.
i. Pump gauge connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
j. Variable-frequency controllers' startup is complete and safeties are verified.
k. Suitable access to balancing devices and equipment is provided.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system in accordance with the procedures contained in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.

B. Cut insulation, ducts, pipes, and equipment casings for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
2. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 233300 "Air Duct Accessories."
3. Where holes for probes are required in piping or hydronic equipment, install pressure and temperature test plugs to seal systems.
4. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish in accordance with Section 230713 "Duct Insulation,"

Section 230716 "HVAC Equipment Insulation," and Section 230719 "HVAC Piping Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 TESTING, ADJUSTING, AND BALANCING OF HVAC EQUIPMENT

A. Test, adjust, and balance HVAC equipment indicated on Drawings, including, but not limited to, the following:

1. Motors.
2. Pumps.
3. Fans and ventilators.
4. Terminal units.
5. Commercial kitchen hoods.
6. Boilers.
7. Heat exchangers.
8. Energy-recovery units.
9. Air-handling units.
10. Rooftop air-conditioning units.
11. Heating-only makeup air units.
12. Packaged air conditioners.
13. Self-contained air conditioners.
14. Split-system air conditioners.

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' Record drawings duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling-unit components.

3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

    a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
    b. Where duct conditions allow, measure airflow by main Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses close to the fan and prior to any outlets, to obtain total airflow.
    c. Where duct conditions are unsuitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.

2. Measure fan static pressures as follows:

    a. Measure static pressure directly at the fan outlet or through the flexible connection.
    b. Measure static pressure directly at the fan inlet or through the flexible connection.
    c. Measure static pressure across each component that makes up the air-handling system.
    d. Report artificial loading of filters at the time static pressures are measured.

3. Review Contractor-prepared shop drawings and Record drawings to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
4. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.

1. Measure airflow of submain and branch ducts.
2. Adjust submain and branch duct volume dampers for specified airflow.
3. Re-measure each submain and branch duct after all have been adjusted.

C. Adjust air inlets and outlets for each space to indicated airflows.

1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
2. Measure inlets and outlets airflow.
3. Adjust each inlet and outlet for specified airflow.
4. Re-measure each inlet and outlet after they have been adjusted.

D. Verify final system conditions.

1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
2. Re-measure and confirm that total airflow is within design.
3. Re-measure all final fan operating data, speed, volts, amps, and static profile.

4. Mark all final settings.
5. Test system in economizer mode. Verify proper operation and adjust if necessary.
6. Measure and record all operating data.
7. Record final fan-performance data.

3.7 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Adjust the variable-air-volume systems as follows:

1. Verify that the system static pressure sensor is located two-thirds of the distance down the duct from the fan discharge.
2. Verify that the system is under static pressure control.
3. Select the terminal unit that is most critical to the supply-fan airflow. Measure inlet static pressure, and adjust system static pressure control set point so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
4. Calibrate and balance each terminal unit for maximum and minimum design airflow as follows:

    a. Adjust controls so that terminal is calling for maximum airflow. Some controllers require starting with minimum airflow. Verify calibration procedure for specific project.
    b. Measure airflow and adjust calibration factor as required for design maximum airflow. Record calibration factor.
    c. When maximum airflow is correct, balance the air outlets downstream from terminal units.
    d. Adjust controls so that terminal is calling for minimum airflow.
    e. Measure airflow and adjust calibration factor as required for design minimum airflow. Record calibration factor. If no minimum calibration is available, note any deviation from design airflow.
    f. On constant volume terminals, in critical areas where room pressure is to be maintained, verify that the airflow remains constant over the full range of full cooling to full heating. Note any deviation from design airflow or room pressure.

5. After terminals have been calibrated and balanced, test and adjust system for total airflow. Adjust fans to deliver total design airflows within the maximum allowable fan speed listed by fan manufacturer.

    a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
    b. Set terminals for maximum airflow. If system design includes diversity, adjust terminals for maximum and minimum airflow, so that connected total matches fan selection and simulates actual load in the building.
    c. Where duct conditions allow, measure airflow by main Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses close to the fan and prior to any outlets, to obtain total airflow.
    d. Where duct conditions are unsuitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.

6. Measure fan static pressures as follows:

    a. Measure static pressure directly at the fan outlet or through the flexible connection.
    b. Measure static pressure directly at the fan inlet or through the flexible connection.

c. Measure static pressure across each component that makes up the air-handling system.
d. Report any artificial loading of filters at the time static pressures are measured.

7. Set final return and outside airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.

a. Balance the return-air ducts and inlets.
b. Verify that terminal units are meeting design airflow under system maximum flow.

8. Re-measure the inlet static pressure at the most critical terminal unit, and adjust the system static pressure set point to the most energy-efficient set point to maintain the optimum system static pressure. Record set point and give to controls Contractor.
9. Verify final system conditions as follows:

a. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to match design if necessary.
b. Re-measure and confirm that total airflow is within design.
c. Re-measure final fan operating data, speed, volts, amps, and static profile.
d. Mark final settings.
e. Test system in economizer mode. Verify proper operation and adjust if necessary. Measure and record all operating data.
f. Verify tracking between supply and return fans.

3.8 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports for pumps, coils, and other equipment. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required coil and equipment flow rates with pump design flow rate.

B. Prepare schematic diagrams of systems' Record drawings piping layouts.

C. In addition to requirements in "Preparation" Article, prepare hydronic systems for testing and balancing as follows:

1. Check expansion tank for proper setting.
2. Check highest vent for adequate pressure.
3. Check flow-control valves for proper position.
4. Locate start-stop and disconnect switches, electrical interlocks, and motor controllers.
5. Verify that motor controllers are equipped with properly sized thermal protection.
6. Check that air has been purged from the system.

D. Measure and record upstream and downstream pressure of each piece of equipment.

E. Measure and record upstream and downstream pressure of pressure-reducing valves.

F. Check settings and operation of automatic temperature-control valves, self-contained control valves, and pressure-reducing valves. Record final settings.

1. Check settings and operation of each safety valve. Record settings.

3.9 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

A. Adjust pumps to deliver total design flow.

1. Measure total water flow.

a. Position valves for full flow through coils.
b. Measure flow by main flow meter, if installed.
c. If main flow meter is not installed, determine flow by pump TDH or known equipment pressure drop.

2. Measure pump TDH as follows:

a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
c. Convert pressure to head and correct for differences in gauge heights.
d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow, and verify that the pump has the intended impeller size.
e. With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved. If excessive throttling is required to achieve desired flow, recommend pump impellers be trimmed to reduce excess throttling.

3. Monitor motor performance during procedures, and do not operate motor in an overloaded condition.

B. Adjust flow-measuring devices installed in mains and branches to design water flows.

1. Measure flow in main and branch pipes.
2. Adjust main and branch balance valves for design flow.
3. Re-measure each main and branch after all have been adjusted.

C. Adjust flow-measuring devices installed at terminals for each space to design water flows.

1. Measure flow at terminals.
2. Adjust each terminal to design flow.
3. Re-measure each terminal after it is adjusted.
4. Position control valves to bypass the coil, and adjust the bypass valve to maintain design flow.
5. Perform temperature tests after flows have been balanced.

D. For systems with pressure-independent valves at terminals:

1. Measure differential pressure and verify that it is within manufacturer's specified range.
2. Perform temperature tests after flows have been verified.

E. For systems without pressure-independent valves or flow-measuring devices at terminals:

1. Measure and balance coils by either coil pressure drop or temperature method.
2. If balanced by coil pressure drop, perform temperature tests after flows have been verified.

F. Verify final system conditions as follows:

1. Re-measure and confirm that total water flow is within design.
2. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
3. Mark final settings.

G. Verify that memory stops have been set.

3.10 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals, and proceed as specified above for hydronic systems.

B. Adjust the variable-flow hydronic system as follows:

1. Verify that the pressure-differential sensor(s) is located as indicated.
2. Determine whether there is diversity in the system.

C. For systems with no flow diversity:

1. Adjust pumps to deliver total design flow.

a. Measure total water flow.

1) Position valves for full flow through coils.
2) Measure flow by main flow meter, if installed.
3) If main flow meter is not installed, determine flow by pump TDH or known equipment pressure drop.

b. Measure pump TDH as follows:

1) Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
2) Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
3) Convert pressure to head and correct for differences in gauge heights.
4) Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow, and verify that the pump has the intended impeller size.
5) With valves open, read pump TDH. Adjust pump discharge valve or speed until design water flow is achieved. If excessive throttling is required to achieve desired flow, recommend pump impellers be trimmed to reduce excess throttling.

c. Monitor motor performance during procedures, and do not operate motor in an overloaded condition.

2. Adjust flow-measuring devices installed in mains and branches to design water flows.

a. Measure flow in main and branch pipes.
b. Adjust main and branch balance valves for design flow.
c. Re-measure each main and branch after all have been adjusted.

3. Adjust flow-measuring devices installed at terminals for each space to design water flows.

a. Measure flow at terminals.
b. Adjust each terminal to design flow.
c. Re-measure each terminal after it is adjusted.
d. Position control valves to bypass the coil, and adjust the bypass valve to maintain design flow.
e. Perform temperature tests after flows have been balanced.

4. For systems with pressure-independent valves at terminals:

   a. Measure differential pressure and verify that it is within manufacturer's specified range.
   b. Perform temperature tests after flows have been verified.

5. For systems without pressure-independent valves or flow-measuring devices at terminals:

   a. Measure and balance coils by either coil pressure drop or temperature method.
   b. If balanced by coil pressure drop, perform temperature tests after flows have been verified.

6. Prior to verifying final system conditions, determine the system pressure-differential set point(s).
7. If the pump discharge valve was used to set total system flow with variable-frequency controller at 60 Hz, at completion, open discharge valve 100 percent, and allow variable-frequency controller to control system differential-pressure set point. Record pump data under both conditions.
8. Mark final settings and verify that all memory stops have been set.
9. Verify final system conditions as follows:

   a. Re-measure and confirm that total flow is within design.
   b. Re-measure final pumps' operating data, TDH, volts, amps, speed, and static profile.
   c. Mark final settings.

D. For systems with flow diversity:

1. Determine diversity factor.
2. Simulate system diversity by closing required number of control valves, as approved by Architect.
3. Adjust pumps to deliver total design flow.

   a. Measure total water flow.

      1) Position valves for full flow through coils.
      2) Measure flow by main flow meter, if installed.
      3) If main flow meter is not installed, determine flow by pump TDH or known equipment pressure drop.

   b. Measure pump TDH as follows:

      1) Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
      2) Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
      3) Convert pressure to head and correct for differences in gauge heights.

4) Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow, and verify that the pump has the intended impeller size.
5) With valves open, read pump TDH. Adjust pump discharge valve or speed until design water flow is achieved. If excessive throttling is required to achieve desired flow, recommend pump impellers be trimmed to reduce excess throttling.

c. Monitor motor performance during procedures, and do not operate motor in an overloaded condition.

4. Adjust flow-measuring devices installed in mains and branches to design water flows.

a. Measure flow in main and branch pipes.
b. Adjust main and branch balance valves for design flow.
c. Re-measure each main and branch after all have been adjusted.

5. Adjust flow-measuring devices installed at terminals for each space to design water flows.

a. Measure flow at terminals.
b. Adjust each terminal to design flow.
c. Re-measure each terminal after it is adjusted.
d. Position control valves to bypass the coil, and adjust the bypass valve to maintain design flow.
e. Perform temperature tests after flows have been balanced.

6. For systems with pressure-independent valves at terminals:

a. Measure differential pressure, and verify that it is within manufacturer's specified range.
b. Perform temperature tests after flows have been verified.

7. For systems without pressure-independent valves or flow-measuring devices at terminals:

a. Measure and balance coils by either coil pressure drop or temperature method.
b. If balanced by coil pressure drop, perform temperature tests after flows have been verified.

8. Open control valves that were shut. Close a sufficient number of control valves that were previously open to maintain diversity, and balance terminals that were just opened.
9. Prior to verifying final system conditions, determine system pressure-differential set point(s).
10. If the pump discharge valve was used to set total system flow with variable-frequency controller at 60 Hz, at completion, open discharge valve 100 percent, and allow variable-frequency controller to control system differential-pressure set point. Record pump data under both conditions.
11. Mark final settings and verify that memory stops have been set.
12. Verify final system conditions as follows:

a. Re-measure and confirm that total water flow is within design.
b. Re-measure final pumps' operating data, TDH, volts, amps, speed, and static profile.
c. Mark final settings.

3.11 PROCEDURES FOR STEAM AND CONDENSATE SYSTEMS

A. Measure and record upstream and downstream pressure of each piece of equipment.

B. Measure and record upstream and downstream steam pressure of pressure-reducing valves.

C. Check settings and operation of automatic temperature-control valves, self-contained control valves, and pressure-reducing valves. Record final settings.

D. Check settings and operation of each safety valve. Record settings.

E. Verify the operation of each steam trap.

3.12 PROCEDURES FOR STEAM-TO-WATER HEAT EXCHANGERS

A. Adjust and record water flow to within specified tolerances.

B. Measure and record inlet and outlet water temperatures.

C. Measure and record inlet steam pressure and condensate outlet pressure.

D. Check and record settings and operation of safety and relief valves.

3.13 PROCEDURES FOR WATER-TO-WATER HEAT EXCHANGERS

A. Adjust and record water flow to within specified tolerances.

B. Measure and record inlet and outlet water temperatures.

C. Measure and record pressure drop.

D. Check and record settings and operation of safety and relief valves.

3.14 PROCEDURES FOR MOTORS

A. Motors 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Phase and hertz.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter size and thermal-protection-element rating.
8. Service factor and frame size.

B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.

3.15 PROCEDURES FOR AIR-COOLED CONDENSING UNITS

A. Verify proper rotation of fan(s).

B. Measure and record entering- and leaving-air temperatures.

C. Measure and record entering and leaving refrigerant pressures.

D. Measure and record operating data of compressor(s), fan(s), and motors.

3.16 PROCEDURES FOR AIR-COOLED CONDENSERS

A. Verify proper rotation of fan(s).

B. Measure and record entering- and leaving-air temperatures.

C. Measure and record entering and leaving refrigerant pressures.

D. Measure and record operating data of fan(s) and motor(s).

3.17 PROCEDURES FOR BOILERS

A. Hydronic Boilers:

1. Measure and record entering- and leaving-water temperatures.
2. Measure and record water flow.
3. Measure and record pressure drop.
4. Measure and Record relief valve(s) pressure setting.
5. Capacity: Calculate in Btu/h of heating output.
6. Fuel Consumption: If boiler fuel supply is equipped with flow meter, measure and record consumption.
7. Efficiency: Calculate operating efficiency for comparison to submitted equipment.
8. Fan, motor, and motor controller operating data.

B. Steam Boilers:

1. Measure and record entering-water temperature.
2. Measure and record feedwater flow.
3. Measure and record leaving-steam pressure and temperature.
4. Measure and Record relief valve(s) pressure setting.
5. Capacity: Calculate in Btu/h of heating output.
6. Efficiency: Calculate operating efficiency for comparison to submitted equipment.
7. Fan, motor, and motor controller operating data.

3.18 PROCEDURES FOR EXHAUST HOODS

A. Kitchen Hoods:

1. Type 1: Measure and record pressure drop and face velocity of hood filters and slots in accordance with hood manufacturer's instructions. Consult hood manufacturer to determine hood airflow using recorded information.
2. Type 2: Measure and record airflow by duct traverse.

3. Capture and Containment: Check each hood for proper capture and containment using a smoke-emitting device. Observe and report performance. Make adjustments to achieve optimum results.

B. AHJ Tests: Conduct additional tests required by authorities having jurisdiction.

3.19 HVAC CONTROLS VERIFICATION

A. In conjunction with system balancing, perform the following:

1. Verify HVAC control system is operating within the design limitations.
2. Confirm that the sequences of operation are in compliance with Contract Documents.
3. Verify that controllers are calibrated and function as intended.
4. Verify that controller set points are as indicated.
5. Verify the operation of lockout or interlock systems.
6. Verify the operation of valve and damper actuators.
7. Verify that controlled devices are properly installed and connected to correct controller.
8. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.
9. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.

B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions.

3.20 TOLERANCES

A. Set HVAC system's airflow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent. If design value is less than 100 cfm, within 10 cfm.
2. Air Outlets and Inlets: Plus or minus 10 percent. If design value is less than 100 cfm, within 10 cfm.
3. Heating-Water Flow Rate: Plus or minus 5 percent. If design value is less than 10 gpm, within 10 percent.
4. Chilled-Water Flow Rate: Plus or minus 5 percent. If design value is less than 10 gpm, within 10 percent.
5. Condenser-Water Flow Rate: Plus or minus 5 percent.

B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.21 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.
3. Certify validity and accuracy of field data.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance; do not include Shop Drawings and Product Data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB specialist.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents, including the following:

    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans performance forms, including the following:

    a. Settings for outdoor-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Heating coil, dry-bulb conditions.
    e. Face and bypass damper settings at coils.
    f. Fan drive settings, including settings and percentage of maximum pitch diameter.
    g. Variable-frequency controller settings for variable-air-volume systems.
    h. Settings for pressure controller(s).
    i. Other system operating conditions that affect performance.

16. Test conditions for pump performance forms, including the following:

    a. Variable-frequency controller settings for variable-flow hydronic systems.
    b. Settings for pressure controller(s).
    c. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Water and steam flow rates.

3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

E. Air-Handling-Unit Test Reports: For air-handling units, include the following:

1. Unit Data:

a. Unit identification.
b. Location.
c. Make and type.
d. Model number and unit size.
e. Manufacturer's serial number.
f. Unit arrangement and class.
g. Discharge arrangement.
h. Sheave make, size in inches, and bore.
i. Center-to-center dimensions of sheave and amount of adjustments in inches.
j. Number, make, and size of belts.
k. Number, type, and size of filters.

2. Motor Data:

a. Motor make, and frame type and size.
b. Horsepower and speed.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Center-to-center dimensions of sheave and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan speed.
d. Inlet and discharge static pressure in inches wg.
e. For each filter bank, filter static-pressure differential in inches wg.
f. Preheat-coil static-pressure differential in inches wg.
g. Cooling-coil static-pressure differential in inches wg.
h. Heating-coil static-pressure differential in inches wg.
i. List for each internal component with pressure-drop, static-pressure differential in inches wg.
j. Outdoor airflow in cfm.
k. Return airflow in cfm.
l. Outdoor-air damper position.
m. Return-air damper position.

F. Apparatus-Coil Test Reports:

1. Coil Data:

a. System identification.
b. Location.
c. Coil type.

d. Number of rows.
e. Fin spacing in fins per inch o.c.
f. Make and model number.
g. Face area in sq. ft..
h. Tube size in NPS.
i. Tube and fin materials.
j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

a. Airflow rate in cfm.
b. Average face velocity in fpm.
c. Air pressure drop in inches wg.
d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
e. Return-air, wet- and dry-bulb temperatures in deg F.
f. Entering-air, wet- and dry-bulb temperatures in deg F.
g. Leaving-air, wet- and dry-bulb temperatures in deg F.
h. Water flow rate in gpm.
i. Water pressure differential in feet of head or psig.
j. Entering-water temperature in deg F.
k. Leaving-water temperature in deg F.
l. Refrigerant expansion valve and refrigerant types.
m. Refrigerant suction pressure in psig.
n. Refrigerant suction temperature in deg F.
o. Inlet steam pressure in psig.

G. Gas- and Oil-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:

1. Unit Data:

a. System identification.
b. Location.
c. Make and type.
d. Model number and unit size.
e. Manufacturer's serial number.
f. Fuel type in input data.
g. Output capacity in Btu/h.
h. Ignition type.
i. Burner-control types.
j. Motor horsepower and speed.
k. Motor volts, phase, and hertz.
l. Motor full-load amperage and service factor.
m. Sheave make, size in inches, and bore.
n. Center-to-center dimensions of sheave and amount of adjustments in inches.

2. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Entering-air temperature in deg F.
c. Leaving-air temperature in deg F.
d. Air temperature differential in deg F.
e. Entering-air static pressure in inches wg.
f. Leaving-air static pressure in inches wg.
g. Air static-pressure differential in inches wg.
h. Low-fire fuel input in Btu/h.

i. High-fire fuel input in Btu/h.
j. Manifold pressure in psig.
k. High-temperature-limit setting in deg F.
l. Operating set point in Btu/h.
m. Motor voltage at each connection.
n. Motor amperage for each phase.
o. Heating value of fuel in Btu/h.

H. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:

1. Unit Data:

a. System identification.
b. Location.
c. Coil identification.
d. Capacity in Btu/h.
e. Number of stages.
f. Connected volts, phase, and hertz.
g. Rated amperage.
h. Airflow rate in cfm.
i. Face area in sq. ft..
j. Minimum face velocity in fpm.

2. Test Data (Indicated and Actual Values):

a. Heat output in Btu/h.
b. Airflow rate in cfm.
c. Air velocity in fpm.
d. Entering-air temperature in deg F.
e. Leaving-air temperature in deg F.
f. Voltage at each connection.
g. Amperage for each phase.

I. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

a. System identification.
b. Location.
c. Make and type.
d. Model number and size.
e. Manufacturer's serial number.
f. Arrangement and class.
g. Sheave make, size in inches, and bore.
h. Center-to-center dimensions of sheave and amount of adjustments in inches.

2. Motor Data:

a. Motor make, and frame type and size.
b. Horsepower and speed.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Center-to-center dimensions of sheave and amount of adjustments in inches.

g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan speed.
d. Discharge static pressure in inches wg.
e. Suction static pressure in inches wg.

J. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:

a. System fan and air-handling-unit number.
b. Location and zone.
c. Traverse air temperature in deg F.
d. Duct static pressure in inches wg.
e. Duct size in inches.
f. Duct area in sq. ft..
g. Indicated airflow rate in cfm.
h. Indicated velocity in fpm.
i. Actual airflow rate in cfm.
j. Actual average velocity in fpm.
k. Barometric pressure in psig.

K. Air-Terminal-Device Reports:

1. Unit Data:

a. System and air-handling unit identification.
b. Location and zone.
c. Apparatus used for test.
d. Area served.
e. Make.
f. Number from system diagram.
g. Type and model number.
h. Size.
i. Effective area in sq. ft..

2. Test Data (Indicated and Actual Values):

a. Airflow rate in cfm.
b. Air velocity in fpm.
c. Preliminary airflow rate as needed in cfm.
d. Preliminary velocity as needed in fpm.
e. Final airflow rate in cfm.
f. Final velocity in fpm.
g. Space temperature in deg F.

L. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:

1. Unit Data:

a. System and air-handling-unit identification.
b. Location and zone.
c. Room or riser served.
d. Coil make and size.
e. Flowmeter type.

2. Test Data (Indicated and Actual Values):

a. Airflow rate in cfm.
b. Entering-water temperature in deg F.
c. Leaving-water temperature in deg F.
d. Water pressure drop in feet of head or psig.
e. Entering-air temperature in deg F.
f. Leaving-air temperature in deg F.

M. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves, and include the following:

1. Unit Data:

a. Unit identification.
b. Location.
c. Service.
d. Make and size.
e. Model number and serial number.
f. Water flow rate in gpm.
g. Water pressure differential in feet of head or psig.
h. Required net positive suction head in feet of head or psig.
i. Pump speed.
j. Impeller diameter in inches.
k. Motor make and frame size.
l. Motor horsepower and rpm.
m. Voltage at each connection.
n. Amperage for each phase.
o. Full-load amperage and service factor.
p. Seal type.

2. Test Data (Indicated and Actual Values):

a. Static head in feet of head or psig.
b. Pump shutoff pressure in feet of head or psig.
c. Actual impeller size in inches.
d. Full-open flow rate in gpm.
e. Full-open pressure in feet of head or psig.
f. Final discharge pressure in feet of head or psig.
g. Final suction pressure in feet of head or psig.
h. Final total pressure in feet of head or psig.
i. Final water flow rate in gpm.
j. Voltage at each connection.
k. Amperage for each phase.

N. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.22 ADDITIONAL TESTS

A. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 23 0593

SECTION 23 0713

DUCT INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes insulating the following duct services:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed, Type I, commercial, kitchen hood exhaust.
4. Indoor, exposed, Type I, commercial, kitchen hood exhaust.
5. Indoor, concealed oven and warewash exhaust.
6. Indoor, exposed oven and warewash exhaust.
7. Outdoor, concealed supply and return.
8. Outdoor, exposed supply and return.

B. Related Requirements:
1. Section 230719 "HVAC Piping Insulation."
2. Section 233113 "Metal Ducts" for duct liners.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
3. Detail application of field-applied jackets.
4. Detail application at linkages of control devices.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or craft training program.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers are to be marked with the manufacturer's name, appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.

1. All Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. All Insulation Installed Indoors; Outdoors-Installed Insulation in Contact with Airstream: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
3. All Insulation Installed Indoors and Outdoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2.2 INSULATION MATERIALS

A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials are to be applied.

B. Products do not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.

D. Insulation materials for use on austenitic stainless steel are qualified as acceptable in accordance with ASTM C795.

E. Foam insulation materials do not use CFC or HCFC blowing agents in the manufacturing process.

F. Flexible Elastomeric: Closed-cell or expanded-rubber materials; suitable for maximum use temperature between minus 70 deg F and 220 deg F. Comply with ASTM C534, Type II for sheet materials.

G. Glass-Fiber Blanket: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 450 deg F in accordance with ASTM C411. Comply with ASTM C553, Type II, and ASTM C1290, Type II with factory-applied vinyl jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

H. High-Temperature, Glass-Fiber Blanket: Glass fibers bonded with a thermosetting resin, unfaced; suitable for maximum use temperature up to 1000 deg F. Comply with ASTM C553, Type V.

I. Mineral Wool Blanket: Basalt volcanic rock-derived fibers bonded with a thermosetting resin, unfaced; suitable for maximum use temperature up to 1200 deg F in accordance with ASTM C447. Comply with ASTM C553.

J. Glass-Fiber Board Insulation: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature between 35 deg F and 250 deg F for jacketed and between 35 deg F and 450 deg F for unfaced in accordance with ASTM C411. Comply with ASTM C612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

K. High-Temperature, Glass-Fiber Board: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 1000 deg F in accordance with ASTM C411. Comply with ASTM C612, Type III, unfaced.

L. Mineral Wool Board: Basalt volcanic rock-derived fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 1100 deg F in accordance with ASTM C411. Comply with ASTM C612, Type III, unfaced.

M. Glass-Fiber, Pipe and Tank: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature between 35 deg F and 850 deg F, in accordance with ASTM C411. Comply with ASTM C1393.
   1. Semirigid board material with factory-applied ASJ jacket.
   2. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

N. Mineral Wool, Pipe and Tank: Mineral wool fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 1000 deg F, in accordance with ASTM C411. Comply with ASTM C1393.
   1. Semirigid board material with factory-applied ASJ jacket.
   2. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.3 FIRE-RATED INSULATION SYSTEMS

A. Fire-Rated Board: Structural-grade, press-molded, xonolite calcium silicate, fireproofing board suitable for operating temperatures up to 1700 deg F. Comply with ASTM C656, Type II, Grade 6. Tested and certified to provide a 2-hour fire rating by an NRTL acceptable to authorities having jurisdiction.

B. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 2-hour fire rating by an NRTL acceptable to authorities having jurisdiction.

2.4 ADHESIVES

A. Materials are compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

C. Glass-Fiber and Mineral Wool Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

D. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

E. PVC Jacket Adhesive: Compatible with PVC jacket.

2.5 MASTICS AND COATINGS

A. Materials are compatible with insulation materials, jackets, and substrates.

B. Vapor-Retarder Mastic, Water Based, Interior Use: Suitable for indoor use on below ambient services.
   1. Water-Vapor Permeance: Comply with ASTM C755, Section 7.2.2, Table 2, for insulation type and service conditions.
   2. Service Temperature Range: Minus 20 to plus 180 deg F.
   3. Comply with MIL-PRF-19565C, Type II, for permeance requirements, with supplier listing on DOD QPD - Qualified Products Database.
   4. Color: White.

C. Vapor-Retarder Mastic, Solvent Based, Interior Use: Suitable for indoor use on below ambient services.
   1. Water-Vapor Permeance: Comply with ASTM C755, Section 7.2.2, Table 2, for insulation type and service conditions.
   2. Service Temperature Range: 0 to 180 deg F.
   3. Color: White.

D. Vapor-Retarder Mastic, Solvent Based, Exterior Use: Suitable for outdoor use on below ambient services.
   1. Water-Vapor Permeance: Comply with ASTM C755, Section 7.2.2, Table 2, for insulation type and service conditions.
   2. Service Temperature Range: Minus 50 to plus 220 deg F.
   3. Color: White.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Water-Vapor Permeance: ASTM E96/E96M, greater than 1.0 perm at manufacturer's recommended dry film thickness.
2. Service Temperature Range: Minus 20 to plus 180 deg F.
3. Color: White.

2.6 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A and are compatible with insulation materials, jackets, and substrates.
   1. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
   2. Service Temperature Range: 0 to plus 180 deg F.
   3. Color: White.

2.7 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:
   1. Materials are compatible with insulation materials, jackets, and substrates.
   2. Fire- and water-resistant, flexible, elastomeric sealant.
   3. Service Temperature Range: Minus 40 to plus 250 deg F.
   4. Color: Aluminum.

B. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:
   1. Materials are compatible with insulation materials, jackets, and substrates.
   2. Fire- and water-resistant, flexible, elastomeric sealant.
   3. Service Temperature Range: Minus 40 to plus 250 deg F.
   4. Color: White.

2.8 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

   1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
   2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
   3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.
   4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C1136, Type II.
   5. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested in accordance with ASTM E96/E96M, Procedure A, and complying with NFPA 90A and NFPA 90B.
   6. ASJ+: All-service jacket composed of aluminum foil reinforced with glass scrim bonded to a kraft paper interleaving with an outer film leaving no paper exposed; complying with ASTM C1136, Types I, II, III, IV, and VII.
   7. PSK Jacket: Aluminum foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C1136, Type II.

2.9 FIELD-APPLIED JACKETS

A. Field-applied jackets comply with ASTM C921, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. Metal Jacket:
   1. Aluminum Jacket: Comply with ASTM B209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.

      a. Factory cut and rolled to size.
      b. Finish and thickness are indicated in field-applied jacket schedules.
      c. Moisture Barrier for Indoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
      d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.

D. Self-Adhesive Outdoor Jacket (Asphaltic): 60-mil-thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with white aluminum-foil facing.

E. Self-Adhesive Indoor/Outdoor Jacket (Non-Asphaltic): Vapor barrier and waterproofing jacket for installation over insulation located aboveground outdoors or indoors. Specialized jacket has five layers of laminated aluminum and polyester film with low-temperature acrylic pressure-sensitive adhesive. Outer aluminum surface is coated with UV-resistant coating for protection from environmental contaminants.
   1. Permeance: 0.00 perm as tested in accordance with ASTM F1249.
   2. Flamespread/Smoke Developed: 25/50 as tested in accordance with ASTM E84.
   3. Aluminum Finish: Smooth.

2.10 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Cloth: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd..

2.11 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
   1. Width: 3 inches.
   2. Thickness: 11.5 mils.
   3. Adhesion: 90 ounces force/inch in width.
   4. Elongation: 2 percent.
   5. Tensile Strength: 40 lbf/inch in width.
   6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.
   1. Width: 3 inches.
   2. Thickness: 6.5 mils.
   3. Adhesion: 90 ounces force/inch in width.
   4. Elongation: 2 percent.

5. Tensile Strength: 40 lbf/inch in width.
6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Width: 2 inches.
2. Thickness: 3.7 mils.
3. Adhesion: 100 ounces force/inch in width.
4. Elongation: 5 percent.
5. Tensile Strength: 34 lbf/inch in width.

2.12 SECUREMENTS

A. Bands:
1. Aluminum: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.
2. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated.

2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.

a.

3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
a. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
b. Spindle: Aluminum, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
a. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
b. Spindle: Nylon, 0.106-inch-diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

D. Wire: 0.062-inch soft-annealed, stainless steel.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, compress, or otherwise damage insulation or jacket.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during application and finishing. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed in accordance with Contract Documents.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.

3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth, but not to the extent of creating wrinkles or areas of compression in the insulation.
2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.

    a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.

L. Cut insulation in a manner to avoid compressing insulation.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install

insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.

1. Comply with requirements in Section 078413 "Penetration Firestopping."

E. Insulation Installation at Floor Penetrations:

1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 INSTALLATION OF FLEXIBLE ELASTOMERIC AND POLYOLEFIN INSULATION

A. Comply with manufacturer's written installation instructions and ASTM C1710.

B. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Square and Rectangular Ducts and Plenums:

1. Provide 1/4 inch more per side for a tight, compression fit.
2. Cut sheet insulation with the following dimensions:

a. Width of duct plus 1/4 inch, one piece.
b. Height of duct plus 1/4 inch, plus thickness of insulation, two pieces.
c. Width of duct plus 1/4 inch, plus two times the thickness of insulation, one piece.

3. Insulate the bottom of the duct with the sheet from (a) above, then the sides with the two sheets from (b) above, and finally the top of the duct with the sheet from (c) above.
4. Insulation without self-adhering backing:

a. Apply 100 percent coverage of manufacturer adhesive on the metal surface, then the insulation, except for the last 1/4 inch where sheets will butt together.
b. Roll sheet down into position.
c. Press two sheets together under compression and apply adhesive at the butt joint to seal the two sheets together.

5. Insulation with self-adhering backing:

a. Peel back release paper in 6- to 8-inch increments and line up sheet.
b. Press firmly to activate adhesive.

c. Align material and continue to line up correctly, pressing firmly while slowly removing release paper.
d. Allow 1/4-inch overlap for compression at butt joints.
e. Apply adhesive at the butt joint to seal the two sheets together.

6. Insulate duct brackets following manufacturer's written installation instructions.

D. Circular Ducts:

1. Determine the circumference of the duct, using a strip of insulation the same thickness as to be used.
2. Cut the sheet to the required size.
3. Apply 100 percent coverage of manufacturer adhesive on the metal surface then the insulation.
4. Apply manufacturer adhesive to the cut surfaces along 100 percent of the longitudinal seam. Press together the seam at the ends and then the middle. Close the entire seam starting from the middle.

3.6 INSTALLATION OF GLASS-FIBER AND MINERAL-WOOL INSULATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

B. Comply with manufacturer's written installation instructions.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
d. Do not overcompress insulation during installation.
e. Impale insulation over pins and attach speed washers.
f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

C. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
d. Do not overcompress insulation during installation.
e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.7 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless steel bands 12 inches o.c. and at end joints.

3.8 FIRE-RATED INSULATION SYSTEM INSTALLATION

A. Comply with manufacturer's written installation instructions.

B. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.

C. Insulate duct access panels and doors to achieve same fire rating as duct.

D. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Section 078413 "Penetration Firestopping."

3.9 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless steel jackets.

3.10 FIELD QUALITY CONTROL

A. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.11 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed, Type I, commercial, kitchen hood exhaust.
4. Indoor, exposed, Type I, commercial, kitchen hood exhaust.
5. Indoor, concealed oven and warewash exhaust.
6. Indoor, exposed oven and warewash exhaust.
7. Outdoor, concealed supply and return.
8. Outdoor, exposed supply and return.

B. Items Not Insulated:

1. Fibrous-glass ducts.
2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
3. Factory-insulated flexible ducts.
4. Factory-insulated plenums and casings.
5. Flexible connectors.
6. Vibration-control devices.
7. Factory-insulated access panels and doors.

3.12 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, round and flat-oval, supply-air duct insulation is one of the following:

1. Flexible Elastomeric: 1inch thick.
2. Glass-Fiber Blanket: 1-1/2 inches thick and 0.75 lb/cu. ft. nominal density.

B. Concealed, round and flat-oval, return-air duct insulation is one of the following:

1. Flexible Elastomeric: 1inch thick.
2. Glass-Fiber Blanket: 1-1/2 inches thick and 0.75 lb/cu. ft. nominal density.

C. Concealed, round and flat-oval, outdoor-air duct insulation is one of the following:

1. Flexible Elastomeric: 1inch thick.
2. Glass-Fiber Blanket: 1-1/2 inches thick and 0.75 lb/cu. ft. nominal density.

D. Concealed, rectangular, supply-air duct insulation is one of the following:

1. Flexible Elastomeric: 1inch thick.
2. Glass-Fiber Blanket: 1-1/2 inches thick and 0.75 lb/cu. ft. nominal density.

E. Concealed, rectangular, return-air duct insulation is one of the following:

1. Flexible Elastomeric: 1inch thick.
2. Glass-Fiber Blanket: 1-1/2 inches thick and 0.75 lb/cu. ft. nominal density.

F. Concealed, rectangular, outdoor-air duct insulation is one of the following:

1. Flexible Elastomeric: 1inch thick.
2. Glass-Fiber Blanket: 1-1/2 inches thick and 0.75 lb/cu. ft. nominal density.

G. Concealed, Type I, Commercial, Kitchen Hood Exhaust Duct and Plenum Insulation: Fire-rated blanket; thickness as required to achieve 2-hour fire rating.

H. Concealed, supply-air plenum insulation is one of the following:

1. Flexible Elastomeric: 1inch thick.
2. Glass-Fiber Blanket: 1-1/2 inches thick and 0.75 lb/cu. ft. nominal density.

I. Concealed, return-air plenum insulation is one of the following:

1. Flexible Elastomeric: 1inch thick.
2. Glass-Fiber Blanket: 1-1/2 inches thick and 0.75 lb/cu. ft. nominal density.

J. Concealed, outdoor-air plenum insulation is one of the following:

1. Flexible Elastomeric: 1inch thick.
2. Glass-Fiber Blanket: 1-1/2 inches thick and 0.75 lb/cu. ft. nominal density.

3.13 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Ducts and Plenums, Concealed:

1. None.

D. Ducts and Plenums, Exposed:

1. None.

END OF SECTION 23 0713

SECTION 23 0716

HVAC EQUIPMENT INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes insulating HVAC equipment that is not factory insulated.

B. Related Sections:

1. Section 230713 "Duct Insulation."
2. Section 230719 "HVAC Piping Insulation."

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied, if any).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail removable insulation at equipment connections.
2. Detail application of field-applied jackets.
3. Detail application at linkages of control devices.
4. Detail field application for each equipment type.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or craft training program.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation system **materials are to be delivered to the Project site in unopened containers**. The packaging is to include, the name of the manufacturer, fabricator, type, description, and size.

1.6 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with equipment Installer for equipment insulation application.

C. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.

1. All Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. All Insulation Installed Indoors; Outdoors-Installed Insulation in Contact with Airstream: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
3. All Insulation Installed Indoors and Outdoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2.2 INSULATION MATERIALS

A. Comply with requirements in "Breeching Insulation Schedule," "Indoor Equipment Insulation Schedule," and "Outdoor, Aboveground Equipment Insulation Schedule" articles for where insulating materials are applied.

B. Products do not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.

D. Insulation materials for use on austenitic stainless steel are qualified as acceptable in accordance with ASTM C795.

E. Foam insulation materials do not use CFC or HCFC blowing agents in the manufacturing process.

F. Calcium Silicate: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C533, Type I or Type II.

1. Prefabricated Fitting Covers: Comply with ASTM C450 and ASTM C585 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

G. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Comply with ASTM C552.
1. Block Insulation: Type I.
2. Special-Shaped Insulation: Type III.
3. Board Insulation: Type IV.
4. Fabricated shapes in accordance with ASTM C450 and ASTM C585.
5. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

H. Flexible Elastomeric: Closed-cell or expanded-rubber materials; suitable for maximum use temperature between minus 70 deg F and 220 deg F. Comply with ASTM C534/C534M, Type II for sheet materials.

I. Glass-Fiber Blanket: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 450 deg F in accordance with ASTM C411. Comply with ASTM C553, Type II, and ASTM C1290, Type II, with factory-applied vinyl jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

J. High-Temperature, Glass-Fiber Blanket: Glass fibers bonded with a thermosetting resin, unfaced; suitable for maximum use temperature up to 1000 deg F. Comply with ASTM C553, Type V.

K. Mineral Wool Blanket: Basalt volcanic rock-derived fibers bonded with a thermosetting resin, unfaced; suitable for maximum use temperature up to 1200 deg F in accordance with ASTM C447. Comply with ASTM C553.

L. Glass-Fiber Board: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature between 35 deg F and 250 deg F for jacketed and between 35 deg F and 450 deg F for unfaced in accordance with ASTM C411. Comply with ASTM C612, Type IA or Type IB. Provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

M. High-Temperature, Glass-Fiber Board: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 1000 deg F in accordance with ASTM C411. Comply with ASTM C612, Type III, unfaced.

N. Mineral Wool Board: Basalt volcanic rock-derived fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 1100 deg F in accordance with ASTM C411. Comply with ASTM C612, Type III, unfaced.

O. Glass-Fiber, Pipe and Tank: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature between 35 deg F and 850 deg F, in accordance with ASTM C411. Comply with ASTM C1393.
1. Semirigid board material with factory-applied ASJ jacket.
2. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

P. Mineral Wool, Pipe and Tank: Mineral wool fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 1000 deg F, in accordance with ASTM C411. Comply with ASTM C1393.

1. Semirigid board material with factory-applied ASJ jacket.

2.3 INSULATING CEMENTS

A. Glass-Fiber and Mineral Wool Insulating Cement: Comply with ASTM C195.

B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C196.

C. Glass-Fiber and Mineral Wool, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C449.

2.4 ADHESIVES

A. Materials are compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg F.

C. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.

D. Polyisocyanurate Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.

E. Flexible Elastomeric and Polyolefin Adhesive: Solvent-based adhesive.
   1. Wet Flash Point: Below 0 deg F
   2. Service Temperature Range: 40 to 200 deg F.
   3. Color: Black.

F. Glass-Fiber and Mineral Wool Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

G. Polystyrene Adhesive: Solvent- or water-based, synthetic resin adhesive with a service temperature range of minus 20 to plus 140 deg F.

H. ASJ Adhesive and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

I. PVC Jacket Adhesive: Compatible with PVC jacket.

2.5 MASTICS AND COATINGS

A. Materials are compatible with insulation materials, jackets, and substrates.

B. Vapor-Retarder Mastic, Water Based: Suitable for indoor and outdoor use on below-ambient services.
   1. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
   2. Service Temperature Range: 0 to plus 180 deg F.
   3. Comply with MIL-PRF-19565C, Type II, for permeance requirements, with supplier listing on DOD QPD - Qualified Products Database.
   4. Color: White.

C. Vapor-Retarder Mastic, Solvent Based, Indoor Use: Suitable for indoor use on below-ambient services.
   1. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
   2. Service Temperature Range: 0 to 180 deg F.
   3. Color: White.

D. Vapor-Retarder Mastic, Solvent Based, Outdoor Use: Suitable for outdoor use on below-ambient services.
   1. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
   2. Service Temperature Range: Minus 50 to plus 220 deg F.
   3. Color: White.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
   1. Water-Vapor Permeance: ASTM E96/E96M, greater than 1.0 perm at manufacturer's recommended dry film thickness.
   2. Service Temperature Range: 0 to plus 180 deg F.
   3. Color: White.

2.6 LAGGING ADHESIVES

A. Adhesives comply with MIL-A-3316C, Class I, Grade A and are compatible with insulation materials, jackets, and substrates.
   1. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over equipment insulation.
   2. Service Temperature Range: 20 to plus 180 deg F.
   3. Color: White.

2.7 SEALANTS

A. Materials are as recommended by the insulation manufacturer and are compatible with insulation materials, jackets, and substrates.

B. Joint Sealants:
   1. Permanently flexible, elastomeric sealant.
   2. Service Temperature Range: Minus 58 to plus 176 deg F.
   3. Color: White or gray.

C. FSK and Metal Jacket Flashing Sealants:
   1. Fire- and water-resistant, flexible, elastomeric sealant.
   2. Service Temperature Range: Minus 40 to plus 250 deg F.
   3. Color: Aluminum.

D. ASJ Flashing Sealants and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
   1. Fire- and water-resistant, flexible, elastomeric sealant.
   2. Service Temperature Range: Minus 40 to plus 250 deg F.
   3. Color: White.

2.8 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.
4. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested in accordance with ASTM E96/E96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.9 FIELD-APPLIED JACKETS

A. Field-applied jackets comply with ASTM C1136, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
1. Adhesive: As recommended by jacket material manufacturer.
2. Color: White.
3. Factory-fabricated tank heads and tank side panels.

D. Metal Jacket:
1. Aluminum Jacket: Comply with ASTM B209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.

    a. Sheet and roll stock ready for shop or field sizing.
    b. Finish and thickness are indicated in field-applied jacket schedules.
    c. Moisture Barrier for Indoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
    d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
    e. Factory-Fabricated Fitting Covers:

        1) Same material, finish, and thickness as jacket.
        2) Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
        3) Tee covers.
        4) Flange and union covers.
        5) End caps.
        6) Beveled collars.
        7) Valve covers.
        8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

E. Self-Adhesive Outdoor Jacket (Asphaltic): 60-mil-thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a cross-laminated polyethylene film covered with white aluminum-foil facing.

F. Self-Adhesive Indoor/Outdoor Jacket (Non-Asphaltic): Vapor barrier and waterproofing jacket for installation over insulation located aboveground outdoors or indoors. Specialized jacket has five layers of laminated aluminum and polyester film with low-temperature acrylic pressure-

sensitive adhesive. Outer aluminum surface is coated with UV-resistant coating for protection from environmental contaminants.
1. Permeance: 0.00 perm as tested in accordance with ASTM F1249.
2. Flamespread/Smoke Developed: 25/50 as tested in accordance with ASTM E84.
3. Aluminum Finish: Smooth.

G. PVDC Jacket for Indoor Applications: 4-mil-thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perm when tested in accordance with ASTM E96/E96M and with a flame-spread index of 10 and a smoke-developed index of 20 when tested in accordance with ASTM E84.

H. PVDC Jacket for Outdoor Applications: 6-mil-thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perm when tested in accordance with ASTM E96/E96M and with a flame-spread index of 25 and a smoke-developed index of 50 when tested in accordance with ASTM E84.

I. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.

2.10 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Cloth: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd..

2.11 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
1. Width: 3 inches.
2. Thickness: 11.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.
1. Width: 3 inches.
2. Thickness: 6.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Width: 2 inches.
2. Thickness: 6 mils.
3. Adhesion: 64 ounces force/inch in width.
4. Elongation: 500 percent.
5. Tensile Strength: 18 lbf/inch in width.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems and equipment to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range of between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
2. Carbon Steel: Coat carbon steel operating at a service temperature of between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the tradesman installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment.

B. Install insulation materials, forms, vapor barriers or retarders, and jackets, of thicknesses required for each item of equipment, as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, compress, or otherwise damage insulation or jacket.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed in accordance with the Contract Documents.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends attached to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth, but not to the extent of creating wrinkles or areas of compression in the insulation.
2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward-clinching staples along edge at 2 inches o.c.
4. For below-ambient services, apply vapor-barrier mastic over staples.
5. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
6. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints.

L. Cut insulation in a manner to avoid compressing insulation.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches in similar fashion to butt joints.

O. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.

6. Cleanouts.

3.4 INSTALLATION OF EQUIPMENT, TANK, AND VESSEL INSULATION

A. Mineral Wool Glass-Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive, anchor pins, and speed washers.

1. Apply adhesives in accordance with manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.
2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
3. Protect exposed corners with secured corner angles.
4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:

    a. Do not weld anchor pins to ASME-labeled pressure vessels.
    b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
    c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints and 16 inches o.c. in both directions.
    d. Do not compress insulation during installation.
    e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
    f. Impale insulation over anchor pins, and attach speed washers.
    g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

5. Secure each layer of insulation with stainless steel or aluminum bands. Select band material compatible with insulation materials.
6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.
7. Stagger joints between insulation layers at least 3 inches.
8. Install insulation in removable and replaceable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.

1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.

2. Seal longitudinal seams and end joints.

C. Insulation Installation on Pumps:

1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch centers, starting at corners. Install 3/8-inch-diameter fasteners with wing nuts. Alternatively, secure the box sections together using a field-adjustable latching mechanism.
2. Fabricate boxes from galvanized steel, at least 0.040 inch thick.
3. For below-ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

3.5 INSTALLATION OF CALCIUM SILICATE INSULATION

A. Insulation Installation on Boiler Breechings:

1. Secure single-layer insulation with stainless steel bands at 12-inch intervals, and tighten bands without deforming insulation material.
2. Install two-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with wire spaced at 12-inch intervals. Secure outer layer with stainless steel bands at 12-inch intervals.
3. On exposed applications without metal jacket, finish insulation surface with a skim coat of mineral-fiber, hydraulic-setting cement. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth. Overlap edges at least 1 inch. Apply finish coat of lagging adhesive over glass cloth. Thin finish coat to achieve smooth, uniform finish.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Install in accordance with manufacturer's written installation instructions and ASTM C1710.

B. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.

5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless steel bands 12 inches o.c. and at end joints.

E. Where PVDC jackets are indicated, install as follows:

1. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches or less. 33-1/2-inch-circumference limit allows for 2-inch-overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
2. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.8 FINISHES

A. Equipment Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless steel jackets.

3.9 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency to perform tests and inspections.

B. Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. All insulation applications will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.10 EQUIPMENT INSULATION SCHEDULE, GENERAL

A. Insulation conductivity and thickness per pipe size comply with schedules in this Section or with requirements of authorities having jurisdiction, whichever is more stringent.

B. Acceptable insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials is Contractor's option.

3.11 BREECHING INSULATION SCHEDULE

A. Round, exposed breeching and connector insulation is one of the following:

1. Calcium Silicate: 4 inches thick.
2. High-Temperature Glass-Fiber Blanket: 3 inches thick and 3 lb/cu. ft. nominal density.
3. Mineral Wool Blanket: 3 inches thick and 4 lb/cu. ft. nominal density.

B. Round, concealed breeching and connector insulation is one of the following:

1. Calcium Silicate: 4 inches thick.
2. High-Temperature Glass-Fiber Blanket: 3 inches thick and 3 lb/cu. ft. nominal density.
3. Mineral Wool Blanket: 3 inches thick and 4 lb/cu. ft. nominal density.

3.12 INDOOR EQUIPMENT INSULATION SCHEDULE

A. Insulate indoor and outdoor equipment that is not factory insulated.

B. Heat-exchanger (water-to-water for heating service) insulation is one of the following:

1. Cellular Glass: 2 inches thick.
2. Glass-Fiber Blanket: 1 inch thick and 3 lb/cu. ft. nominal density.
3. Glass-Fiber Board: 1 inch thick and 3 lb/cu. ft. nominal density.
4. Glass-Fiber Pipe and Tank: 1 inch thick.

C. Heat-exchanger (water-to-DX for Pool Water Cooling service) insulation is one of the following:
1. Glass-Fiber Blanket: 2 inch thick and 3 lb/cu. ft. nominal density.
2. Glass-Fiber Board: 2 inch thick and 3 lb/cu. ft. nominal density.
3. Glass-Fiber Pipe and Tank: 2 inch thick.Do not retain the first paragraph below if steam-to-steam generator is specified to be factory insulated. Retain “one of” option in first paragraph below to allow Contractor to select materials from those retained.

D. Steam-to-steam generator insulation is one of the following:

1. Cellular Glass: 2 inches thick.
2. Glass-Fiber Blanket: 1 inch thick and 3 lb/cu. ft. nominal density.
3. Glass-Fiber Board: 1 inch thick and 3 lb/cu. ft. nominal density.
4. Glass-Fiber Pipe and Tank: 1 inch thick.

E. Heating-hot-water expansion/compression tank insulation is one of the following:
   1. Glass-Fiber Pipe and Tank: 2 inches thick.

F. Heating-hot-water air-separator insulation is the following:
   1. Glass-Fiber Pipe and Tank: 2 inches thick.

3.13 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Equipment, Concealed:
   1. PVC: 20 mils thick.
   2. Aluminum, Smooth: 0.032 inch thick.

D. Equipment, Exposed, up to 48 Inches in Diameter or with Flat Surfaces of up to 72 Inches:
   1. PVC: 20 mils thick.
   2. Aluminum, Smooth: 0.032 inch thick.

E. Equipment, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches:
   1. PVC: 20 mils thick.
   2. Aluminum, Smooth: 0.032 inch thick.

END OF SECTION 23 0716

SECTION 23 0719

HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes insulation for HVAC piping systems.

B. Related Requirements:

1. Section 230713 "Duct Insulation" for duct insulation.
2. Section 230716 "HVAC Equipment Insulation" for equipment insulation.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied, if any).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or craft training program.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation system materials are to be delivered to the Project site in unopened containers. The packaging is to include name of manufacturer, fabricator, type, description, and size.

1.6 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84 by a testing agency acceptable to authority having jurisdiction. Factory label insulation, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.

1. All Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. All Insulation Installed Indoors; Outdoors-Installed Insulation in Contact with Airstream: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
3. All Insulation Installed Indoors and Outdoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2.2 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials are applied.

B. Products do not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come into contact with stainless steel have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.

D. Insulation materials for use on austenitic stainless steel are qualified as acceptable in accordance with ASTM C795.

E. Foam insulation materials do not use CFC or HCFC blowing agents in the manufacturing process.

F. Flexible Elastomeric: Closed-cell, or expanded-rubber materials; suitable for maximum use temperature between minus 70 deg F and 220 deg F. Comply with ASTM C534/C534M, Type I, for tubular materials, Type II for sheet materials.

G. Glass-Fiber, Preformed Pipe: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 850 deg F in accordance with ASTM C411. Comply with ASTM C547.
   1. Preformed Pipe Insulation: Type I, Grade A with factory-applied ASJ.
   2. Fabricated shapes in accordance with ASTM C450 and ASTM C585.
   3. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

H. Glass-Fiber, Pipe and Tank: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature between 35 deg F and 850 deg F, in accordance with ASTM C411. Comply with ASTM C1393.
   1. Semirigid board material with factory-applied [**ASJ**] [**FSK**] [**ASJ+**] [**PSK**] jacket.
   2. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.3 INSULATING CEMENTS

A. Glass-Fiber and Mineral Wool Insulating Cement: Comply with ASTM C195.

B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C196.

C. Glass-Fiber and Mineral Wool Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C449.

2.4 ADHESIVES

A. Materials are compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Flexible Elastomeric and Polyolefin Adhesive: Solvent-based adhesive.
   1. Flame-spread index is 25 or less and smoke-developed index is 50 or less as tested in accordance with ASTM E84.
   2. Wet Flash Point: Below 0 deg F.
   3. Service Temperature Range: 40 to 200 deg F.
   4. Color: Black.

C. Glass-Fiber and Mineral Wool Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

D. ASJ Adhesive and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A, for bonding insulation jacket lap seams and joints.

E. PVC Jacket Adhesive: Compatible with PVC jacket.

2.5 MASTICS AND COATINGS

A. Materials are compatible with insulation materials, jackets, and substrates.

B. Vapor-Retarder Mastic, Water Based: Suitable for indoor use on below-ambient services.
   1. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
   2. Service Temperature Range: 0 to plus 180 deg F.
   3. Comply with MIL-PRF-19565C, Type II, for permeance requirements.
   4. Color: White.

C. Vapor-Retarder Mastic, Solvent Based, Indoor Use: Suitable for indoor use on below-ambient services.
   1. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
   2. Service Temperature Range: 0 to 180 deg F.
   3. Color: White.

D. Vapor-Retarder Mastic, Solvent Based, Outdoor Use: Suitable for outdoor use on below-ambient services.
   1. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
   2. Service Temperature Range: Minus 50 to plus 220 deg F.
   3. Color: White.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
   1. Water-Vapor Permeance: ASTM E96/E96M, greater than 1.0 perm at manufacturer's recommended dry film thickness.
   2. Service Temperature Range: 0 to plus 180 deg F.
   3. Color: White.

2.6 LAGGING ADHESIVES

A. Adhesives comply with MIL-A-3316C, Class I, Grade A, and are compatible with insulation materials, jackets, and substrates.
   1. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
   2. Service Temperature Range: 20 to plus 180 deg F.
   3. Color: White.

2.7 SEALANTS

A. Materials are as recommended by the insulation manufacturer and are compatible with insulation materials, jackets, and substrates.

B. Joint Sealants:
   1. Permanently flexible, elastomeric sealant.
      a. Service Temperature Range: Minus 150 to plus 250 deg F.
      b. Color: White or gray.

C. FSK and Metal Jacket Flashing Sealants:
   1. Fire- and water-resistant, flexible, elastomeric sealant.
   2. Service Temperature Range: Minus 40 to plus 250 deg F.
   3. Color: Aluminum.

D. ASJ Flashing Sealants and PVDC and PVC Jacket Flashing Sealants:
   1. Fire- and water-resistant, flexible, elastomeric sealant.
   2. Service Temperature Range: Minus 40 to plus 250 deg F.
   3. Color: White.

2.8 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

   1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
   2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
   3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.
   4. ASJ+: Aluminum foil reinforced with glass scrim bonded to a kraft paper interleaving with an outer film leaving no paper exposed; complying with ASTM C1136, Types I, II, III, IV, and VII.
   5. PSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C1136, Type II.

2.9 FIELD-APPLIED JACKETS

A. Field-applied jackets comply with ASTM C1136, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
   1. Adhesive: As recommended by jacket material manufacturer.
   2. Color: White.
   3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

      a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

D. Metal Jacket:
   1. Aluminum Jacket: Comply with ASTM B209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.

      a. Sheet and roll stock ready for shop or field sizing.
      b. Finish and thickness are indicated in field-applied jacket schedules.
      c. Moisture Barrier for Indoor Applications: 1-mil-thick, heat-bonded polyethylene and kraft paper.
      d. Moisture Barrier for Outdoor Applications: 53-mil-thick, heat-bonded polyethylene and kraft paper.
      e. Factory-Fabricated Fitting Covers:

         1) Same material, finish, and thickness as jacket.

2) Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
3) Tee covers.
4) Flange and union covers.
5) End caps.
6) Beveled collars.
7) Valve covers.
8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

E. Self-Adhesive Outdoor Jacket (Asphaltic): 60-mil-thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a cross-laminated polyethylene film covered with white aluminum-foil facing.

F. Self-Adhesive Indoor/Outdoor Jacket (Non-Asphaltic): Vapor barrier and waterproofing jacket for installation over insulation located aboveground outdoors or indoors. Specialized jacket has five layers of laminated aluminum and polyester film with low-temperature acrylic pressure-sensitive adhesive. Outer aluminum surface is coated with UV-resistant coating for protection from environmental contaminants.
1. Permeance: 0.00 perm as tested in accordance with ASTM F1249.
2. Flamespread/Smoke Developed: 25/50 as tested in accordance with ASTM E84.
3. Aluminum Finish: Smooth.

2.10 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
1. Width: 3 inches.
2. Thickness: 11.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.
1. Width: 3 inches.
2. Thickness: 6.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Width: 2 inches.
2. Thickness: 6 mils.
3. Adhesion: 64 ounces force/inch in width.
4. Elongation: 500 percent.
5. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Width: 2 inches.
2. Thickness: 3.7 mils.

3. Adhesion: 100 ounces force/inch in width.
4. Elongation: 5 percent.
5. Tensile Strength: 34 lbf/inch in width.

2.11 SECUREMENTS

A. Bands:
1. Stainless Steel: ASTM A240/A240M, Type 304; 0.015 inch thick, 1/2 inch wide with wing seal or closed seal.
2. Aluminum: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.
3. Springs: Twin spring set constructed of stainless steel, with ends flat and slotted to accept metal bands. Spring size is determined by manufacturer for application.

B. Staples: Outward-clinching insulation staples, nominal 3/4 inch wide, stainless steel or Monel.

C. Wire: 0.080-inch nickel-copper alloy.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
2. Carbon Steel: Coat carbon steel operating at a service temperature of between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the tradesman installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of pipe system, as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, compress, or otherwise damage insulation or jacket.

D. Install insulation with longitudinal seams at top and bottom (12 o'clock and 6 o'clock positions) of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed in accordance with the Contract Documents.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

    1. Install insulation continuously through hangers and around anchor attachments.
    2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends attached to structure with vapor-barrier mastic.
    3. Install insert materials and insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
    4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

    1. Draw jacket tight and smooth, but not to the extent of creating wrinkles or areas of compression in the insulation.
    2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced 4 inches o.c.
    3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward-clinching staples along edge at 2 inches o.c.
    4. For below-ambient services, apply vapor-barrier mastic over staples.

5. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
6. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches in similar fashion to butt joints.

P. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials, except where more specific requirements are specified in various pipe insulation material installation articles below.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, Mechanical Couplings, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using prefabricated fitting insulation or mitered or routed fittings made from same material and density as that of adjacent pipe insulation. Each piece is butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with prefabricated fitting insulation or sectional pipe insulation of same material and thickness as that used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using prefabricated fitting insulation or sectional pipe insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using prefabricated fitting insulation or sectional pipe insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers, so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges, mechanical couplings, and unions using a section of oversized preformed pipe insulation to fit. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket, except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing, using PVC tape.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers. Installation conforms to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as that of adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least 2 times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as that of pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install sections of pipe insulation and miter if required in accordance with manufacturer's written instructions.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install prefabricated valve covers manufactured of same material as that of pipe insulation when available.

2. When prefabricated valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 INSTALLATION OF GLASS-FIBER AND MINERAL WOOL INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install prefabricated pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with glass-fiber or mineral-wool blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available.
2. When prefabricated sections are not available, install fabricated sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.8 INSTALLATION OF FIELD-APPLIED JACKETS

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated and for horizontal applications, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless steel bands 12 inches o.c. and at end joints.

E. Where PVDC jackets are indicated, install as follows:

1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
2. Wrap presized jackets around individual pipe insulation sections, with one end overlapping the previously installed sheet. Install presized jacket with an approximate overlap at butt joint of 2 inches over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
3. Continuous jacket can be spiral-wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
4. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches or less. The 33-1/2-inch-circumference limit allows for 2-inch-overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.9 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless steel jackets.

3.10 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency to perform tests and inspections.

B. Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections.

E. All insulation applications will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

3.11 PIPING INSULATION SCHEDULE, GENERAL

A. Insulation conductivity and thickness per pipe size comply with schedules in this Section or with requirements of authorities having jurisdiction, whichever is more stringent.

B. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

C. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Underground piping.
2. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.12 INDOOR PIPING INSULATION SCHEDULE

A. Condensate and Equipment Drain Water below 60 Deg F:

1. All Pipe Sizes: Insulation is one of the following:
    a. Glass-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.

B. Heating-Hot-Water Supply and Return, 200 Deg F and Below:

1. NPS 12 and Smaller: Insulation is one of the following:
    a. Glass-Fiber, Preformed Pipe, Type I: 2 inches thick.

C. Steamer Discharge Piping:

1. NPS 3/4 and Smaller: Insulation is one of the following:
    a. Glass-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches thick.

2. NPS 1 and Larger: Insulation is one of the following:
    a. Glass-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches thick.

D. Refrigerant Suction and Hot-Gas Piping:

1. All Pipe Sizes: Insulation is one of the following:
    a. Flexible Elastomeric: 1 inch thick.

E. Refrigerant Suction and Hot-Gas Flexible Tubing:

1. All Pipe Sizes: Insulation is one of the following:

    a. Flexible Elastomeric: 1/2 inches thick.

3.13 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Refrigerant Suction and Hot-Gas Piping:

1. All Pipe Sizes: Insulation is one of the following:
    a. Flexible Elastomeric: 2 inches thick.

B. Refrigerant Suction and Hot-Gas Flexible Tubing:

1. All Pipe Sizes: Insulation is the following:

    a. Flexible Elastomeric: 2 inches thick.

3.14 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:

1. None.

D. Piping, Exposed:
1. PVC: 30 mils thick.

3.15 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Exposed:
   1. Aluminum, Smooth: 0.032 inch thick.

END OF SECTION 23 0719

SECTION 23 0800

COMMISSIONING OF HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes specific requirements that apply to the implementation of the Commissioning Process and this Division Contractors' participation in this process. This section details the project specific equipment and systems that are included in the Commissioning Process. For general descriptions and responsibilities, refer to SECTION 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

1.2 RELATED DOCUMENTS

A. The Owner's Project Requirements (OPR) document.

B. The Basis of Design (BoD) document.

C. The Project Commissioning Plan (CxP) document.

D. ASHRAE Standard 202-2013 - Commissioning Process for Buildings and Systems.

E. LEED v4 for Building Design and Construction.

1.3 RELATED SECTIONS

A. SECTION 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS

B. SECTION 07 08 00 - COMMISSIONING OF THERMAL AND MOISTURE PROTECTION

C. SECTION 08 08 00 - COMMISSIONING OF OPENINGS

D. SECTION 11 08 00 - COMMISSIONING OF EQUIPMENT

E. SECTION 13 08 00 - COMMISSIONING OF SPECIAL CONSTRUCTION

F. SECTION 14 08 00 - COMMISSIONING OF CONVEYING SYSTEMS

G. SECTION 21 08 00 - COMMISSIONING OF FIRE SUPPRESSION SYSTEMS

H. SECTION 22 08 00 - COMMISSIONING OF PLUMBING SYSTEMS

I. SECTION 25 08 00 - COMMISSIONING OF INTEGRATED AUTOMATION SYSTEMS

J. SECTION 26 08 00 - COMMISSIONING OF ELECTRICAL SYSTEMS

K. SECTION 27 08 00 - COMMISSIONING OF COMMUNICATIONS SYSTEMS

L. SECTION 28 08 00 - COMMISSIONING OF SAFETY AND SECURITY SYSTEMS

M. SECTION 33 08 00 - COMMISSIONING OF UTILITIES

1.4 DEFINITIONS

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

1.5 RESPONSIBILITIES

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

PART 2 - PRODUCTS

2.1 NO PRODUCTS SUPPLIED

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

B. Contractors and/or Vendors shall provide the specialty testing equipment necessary to fulfill the functional testing requirements, for the duration of the testing period.

PART 3 - EXECUTION

3.1 GENERAL

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.2 MEETINGS

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.3 SYSTEM START-UP

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.4 PRE-FUNCTIONAL CHECKLISTS

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.5 FUNCTIONAL PERFORMANCE TESTING

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.6 TRAINING

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.7 SYSTEMS TO BE COMMISSIONED

A. GENERAL
   1. Commissioning specifications supplement the requirements of individual specifications sections but shall not be interpreted to replace or diminish the specified scope of any individual section.
   2. For all systems listed below, Division Contractor shall comply with all commissioning requirements specified.

B. APPLICABLE SYSTEMS
   1. Testing Adjusting and Balancing
   2. Condensing Boilers
   3. Heat Exchangers
   4. Heating Water Piping
   5. Heating Water Pumps
   6. Energy Recovery Systems
   7. Packaged Rooftop Air Conditioning Units.
   8. Split-System Air-Conditioning Units
   9. Power Ventilators
   10. Water Treatment Systems
   11. General-Duty Valves for HVAC
   12. Hangers and Supports for HVAC
   13. Identification for HVAC
   14. HVAC Insulation
   15. Metal Ducts
   16. Nonmetal Ducts
   17. Duct Accessories

END OF SECTION 23 0800

SECTION 23 0934

VARIABLE-FREQUENCY MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes separately enclosed, preassembled, combination VFCs, rated 600 V and less, for speed control of three-phase, induction motors.

B. Related Requirements:

1. Section 262419 "Motor-Control Centers" for VFCs installed in motor-control centers.

1.2 DEFINITIONS

A. CE: Conformite Europeene (European Compliance).

B. CPT: Control power transformer.

C. DDC: Direct digital control.

D. EMI: Electromagnetic interference.

E. LED: Light-emitting diode.

F. NC: Normally closed.

G. NO: Normally open.

H. OCPD: Overcurrent protective device.

I. PID: Control action, proportional plus integral plus derivative.

J. RFI: Radio-frequency interference.

K. VFC: Variable-frequency motor controller.

1.3 ACTION SUBMITTALS

A. Product Data: For each type and rating of VFC indicated.

1. Include dimensions and finishes for VFCs.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Seismic Qualification Data: Certificates, for each VFC, accessories, and components, from manufacturer.

1. Certificate of compliance.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based, and their installation requirements.

C. Product Certificates: For each VFC from manufacturer.

D. Harmonic Analysis Report: Provide Project-specific calculations and manufacturer's statement of compliance with IEEE 519.

E. Source quality-control reports.

F. Field quality-control reports.

G. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For VFCs to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. Manufacturer's written instructions for testing and adjusting thermal-magnetic circuit breaker and motor-circuit protector trip settings.
b. Manufacturer's written instructions for setting field-adjustable overload relays.
c. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
d. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.
e. Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate, full-load currents.
f. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor-running overload protection suit actual motors to be protected.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Accredited by NETA.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

1.7 DELIVERY, STORAGE, AND HANDLING

A. If stored in space that is not permanently enclosed and air conditioned, remove loose packing and flammable materials from inside controllers and install temporary electric heating, with at least 250 W per controller.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for VFCs, including clearances between VFCs, and adjacent surfaces and other items.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace VFCs that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. MAKE: ABB, Danfoss

B. MODEL: ACH580, or approved equal

2.2 MANUFACTURED UNITS

A. Description: Variable-frequency power converter (rectifier, DC Bus, and IGBT, PWM inverter) factory packaged in an enclosure, with integral disconnecting means and overcurrent and overload protection; listed and labeled by an NRTL as a complete unit; arranged to provide self-protection, protection, and variable-speed control of one or more three-phase induction motors by adjusting output voltage and frequency.

B. Units suitable for operation of inverter-duty motors as defined by NEMA MG 1, Section IV, Part 31, "Definite-Purpose Inverter-Fed Poly-Phase Motors."

C. Listed and labeled for integrated short-circuit current (withstand) rating by an NRTL acceptable to authorities having jurisdiction.

D. General Requirements for VFDs: Comply with NEMA ICS 7, NEMA ICS 61800-2.

E. Output Rating: Three-phase; 10 to 60 Hz, with voltage proportional to frequency throughout voltage range for variable-torque controllers: 10 to 66 Hz, with torque constant as speed changes for constant-torque controllers; maximum voltage equals input voltage.

F. Unit Operating Requirements:
1. Input AC Voltage Tolerance: Plus 10 and minus 10 percent of VFD input voltage rating.
2. Input AC Voltage Unbalance: Not exceeding 3 percent.
3. Input Frequency Tolerance: Plus or minus 3 percent of VFD frequency rating.
4. Minimum Efficiency: 97 percent at 60 Hz, full load.
5. Minimum Displacement Primary-Side Power Factor: 97 percent under any load or speed condition.

6. Vibration Withstand: Comply with IEC 60068-2-6.
7. Overload Capability: Minimum 1.1 times the base load current for 60 seconds for variable torque controllers; minimum of 1.5 times the base load current for three seconds for constant torque controllers.
8. Starting Torque: Minimum 100 percent of rated torque from 3 to 60 Hz.
9. Speed Regulation: Plus or minus 5 percent.
10. Output Carrier Frequency: Selectable; minimum 2kHz-10kHz for 1-40 HP at 208/240V and 1- 75HP at 460V; minimum 2kHz-8kHz for 50-100HP at 208-240V and 100-200HP at 460V.
11. Stop Modes: Programmable; includes fast, free-wheel, and DC Injection braking.

G. Internal Adjustability Capabilities:
1. Minimum Speed: 5 to 25 percent of maximum rpm.
2. Maximum Speed: 80 to 100 percent of maximum rpm.
3. Acceleration: 0.1 to 999.9 seconds.
4. Deceleration: 0.1 to 999.9 seconds.
5. Current Limit: 30 to minimum of 150 percent of maximum rating.

H. Self-Protection and Reliability Features:
1. Input transient protection by means of surge suppressors to provide three-phase protection against damage from supply voltage surges 10 percent or more above nominal line voltage.
2. Loss of Input Signal Protection: Selectable response strategy, including speed default to a percent of the most recent speed, a preset speed, or stop; with alarm.
3. Under- and overvoltage trips.
4. Inverter overcurrent trips.
5. VFD and Motor Overload/Overtemp Protection.
6. Instantaneous line-to-line and line-to-ground overcurrent trips.
7. Loss-of-phase protection.
8. Reverse-phase protection.
9. Short-circuit protection.
10. Motor Over temperature fault.
11. Fast acting VFD isolation fuses to disconnect VFD from the line prior to the clearing of upstream branch circuit protection.
12. Automatic Reset/Restart: Attempt three restarts after drive fault or on return of power after an interruption and before shutting down for manual reset or fault correction; adjustable delay time between restart attempts.
13. Bidirectional Auto speed Search: Capable of starting VFD into rotating loads spinning in either direction and returning motor to set speed in proper direction, without causing damage to drive, motor, or load.
14. Integral Input Disconnecting Means and OCPD: NEMA KS 1, fusible switch with pad-lockable, door-mounted handle mechanism.

2.3 CONTROLS AND INDICATION

A. Status Lights: Door-mounted indicators displaying the following conditions:
1. Power on.
2. Run.
3. Overvoltage.
4. Line fault.
5. Overcurrent.
6. External fault.

B. Panel-Mounted Operator Station: Manufacturer's standard front-accessible, sealed keypad and plain- English language digital display; allows complete programming, operating, monitoring, and diagnostic capability.
   1. Historical Logging Information and Displays:
   2. Kilowatt-hours consumption.
   3. Running log of total power versus time.
   4. Total run time.
   5. Fault log, maintaining last three faults with time and date stamp for each.

C. Indicating Devices: Digital display and additional readout devices as required, mounted flush in VFD door and connected to display VFD parameters including, but not limited to:
   1. Output frequency (Hz).
   2. Motor speed (rpm).
   3. Motor status (running, stop, fault).
   4. Motor current (amperes).
   5. Motor torque (percent).
   6. Fault or alarming status (code).
   7. PID feedback signal (percent).
   8. DC-link voltage (V dc).
   9. Set point frequency (Hz).
   10. Motor output voltage (V ac).

2.4 CONTROL SIGNAL INTERFACES:

A. Electric Input Signal Interface:
   1. A minimum of one programmable analog input: 0 to 10 VDC.
   2. A minimum of one programmable analog input: 4 to 20 mA DC.
   3. A minimum of three multifunction programmable digital inputs.

B. Output Signal Interface: A minimum of one programmable analog output signal(s) 0- to 10-V dc and one programmable analog output signal 4- to 20-mA dc, which can be configured for any of the following:
   1. Output frequency (Hz).
   2. Output current (load).
   3. DC-link voltage (VDC).
   4. Motor torque (percent).
   5. Motor speed (rpm).
   6. Setpoint frequency (Hz).

C. Remote Indication Interface: A minimum of two programmable dry-circuit relay outputs (120-VAC, 1 A) for remote indication of the following:
   1. Motor running.
   2. Set point speed reached.
   3. Fault and warning indication (over temperature or overcurrent).
   4. PID high- or low-speed limits reached.

D. Interface: Factory-installed hardware and software to enable the IAS to monitor, control, and display VFD status and alarms and energy usage. Allows VFD to be used with an external system within a multidrop LAN configuration; settings retained within VFDs nonvolatile memory.
   1. Network Communications Ports: Ethernet and RS-485.
   2. Embedded Native Protocols for Network Communications: ASHRAE 135 BACnet protocol accessible via the communications ports.

2.5 LINE CONDITIONING AND FILTERING

A. Input Line Conditioning: When indicated on the VFD schedule on the plans, provide input filtering, as required, to limit TDD at input terminals to less than 5 percent and THD (V) to 3 percent.

B. Output Filtering: Provide output line inductors when indicated on the VFD schedule on the plans.

C. EMI/RFI Filtering: Provide EMI/RFI filtering when indicated on the VFD schedule on the plans. CE marked; certify compliance with IEC 61800-3 for Category C2.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, surfaces, and substrates to receive VFCs, with Installer present, for compliance with requirements for installation tolerances, <**insert Project-specific conditions,**> and other conditions affecting performance of the Work.

B. Examine VFC before installation. Reject VFCs that are wet, moisture damaged, or mold damaged.

C. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFC installation.

D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Wall-Mounting Controllers: Install with tops at uniform height and with disconnect operating handles not higher than 79 inches above finished floor, unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not on walls, provide freestanding racks complying with Section 260529 "Hangers and Supports for Electrical Systems."

B. Floor-Mounting Controllers: Install VFCs on 4-inch nominal thickness concrete base. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.

C. Roof-Mounting Controllers: Install VFC on roofs with tops at uniform height and with disconnect operating handles not higher than 79 inches above finished roof surface unless otherwise

indicated, and by bolting units to curbs or mounting on freestanding, lightweight, structural-steel channels bolted to curbs. Seal roof penetrations after raceways are installed.

1. Curbs and roof penetrations are specified in Section 077200 "Roof Accessories."
2. Structural-steel channels are specified in Section 260529 "Hangers and Supports for Electrical Systems."

D. Seismic Bracing: Comply with requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

F. Install fuses in each fusible-switch VFC.

G. Install fuses in control circuits if not factory installed. Comply with requirements in Section 262813 "Fuses."

H. Install heaters in thermal-overload relays. Select heaters based on actual nameplate full-load amperes after motors are installed.

I. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.

J. Comply with NECA 1.

3.3 CONTROL WIRING INSTALLATION

A. Install wiring between VFCs and remote devices and facility's central-control system. Comply with requirements in Section 260523 "Control-Voltage Electrical Power Cables."

B. Bundle, train, and support wiring in enclosures.

C. Connect selector switches and other automatic-control devices where applicable.

1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switches are in manual-control position.
2. Connect selector switches with control circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor-overload protectors.

3.4 IDENTIFICATION

A. Identify VFCs, components, and control wiring. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each VFC with engraved nameplate.
3. Label each enclosure-mounted control and pilot device.

B. Operating Instructions: Frame printed operating instructions for VFCs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of VFC units.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections with the assistance of a factory-authorized service representative.

D. Acceptance Testing Preparation:

1. Test insulation resistance for each VFC element, bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

E. Tests and Inspections:

1. Inspect VFC, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
2. Test insulation resistance for each VFC element, component, connecting motor supply, feeder, and control circuits.
3. Test continuity of each circuit.
4. Verify that voltages at VFC locations are within 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Construction Manager before starting the motor(s).
5. Test each motor for proper phase rotation.
6. Perform tests according to the Inspection and Test Procedures for Adjustable Speed Drives stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
8. Perform the following infrared (thermographic) scan tests and inspections, and prepare reports:

    a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each VFC. Remove front panels so joints and connections are accessible to portable scanner.
    b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each VFC 11 months after date of Substantial Completion.
    c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

9. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

F. VFCs will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies the VFC and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.7 ADJUSTING

A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.

B. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

C. Adjust the trip settings of instantaneous-only circuit breakers and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements. Initially adjust to 6 times the motor nameplate full-load amperes and attempt to start motors several times, allowing for motor cool-down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed 8 times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Construction Manager before increasing settings.

D. Set the taps on reduced-voltage autotransformer controllers.

E. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573.16 "Coordination Studies."

F. Set field-adjustable pressure switches.

3.8 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until controllers are ready to be energized and placed into service.

B. Replace VFCs whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, reprogram, and maintain VFCs.

END OF SECTION 23 0934

SECTION 23 1123

FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipes, tubes, and fittings.
2. Manual gas shutoff valves.
3. Earthquake valves.
4. Pressure regulators.
5. Dielectric fittings.

1.2 DEFINITIONS

A. CWP: Cold working pressure.

B. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. An example includes rooftop locations.

C. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

D. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Piping specialties.
2. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
3. Pressure regulators. Indicate pressure ratings and capacities.
4. Dielectric fittings.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans and details, drawn to scale, on which natural-gas piping is shown and coordinated with other installations, using input from installers of the items involved.

B. Welding certificates.

C. Site Survey: Plans, drawn to scale, on which natural-gas piping is shown and coordinated with other services and utilities.

D. Field quality-control reports.

E. Qualification Statements: For professional engineer.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For pressure regulators and service meters to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Steel Support Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators in accordance with the ASME Boiler and Pressure Vessel Code.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping in accordance with requirements of authorities having jurisdiction.

B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.

D. Protect stored PE pipes and valves from direct sunlight.

1.8 PROJECT CONDITIONS

A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.

B. Interruption of Existing Natural-Gas Service: Do not interrupt natural-gas service to facilities occupied by Owner or others unless permitted under the following conditions, and then only after arranging to provide purging and startup of natural-gas supply in accordance with requirements indicated:

1. NotifyConstruction Manager no fewer than two days in advance of proposed interruption of natural-gas service.
2. Do not proceed with interruption of natural-gas service withoutConstruction Manager's written permission.

1.9 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

B. Coordinate requirements for access panels and doors for valves installed and concealed behind finished surfaces. Comply with requirements in Section 083113 "Access Doors and Frames."

C. Coordinate requirements for piping identification for natural-gas piping. Comply with requirements in Section 220553 "Identification of Plumbing Piping and Equipment."

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain each product type from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Comply withthe International Fuel Gas Code.

B. Minimum Operating-Pressure Ratings:

1. Piping and Valves: 100 psig minimum unless otherwise indicated.
2. Service Regulators: 65 psig minimum unless otherwise indicated.
3. Minimum Operating Pressure of Service Meter: 5 psig.

C. Natural-Gas System Pressure within Buildings:

1. Two pressure ranges. Primary pressure is more than 0.5 psig, but not more than 2 psig, and is reduced to secondary pressure of 0.5 psig or less.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Seismic Performance: Natural-gas piping system is to withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7. See Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

1. The term "withstand" means "the piping system will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
2. Component Importance Factor: 1.0.

2.3 PIPES, TUBES, AND FITTINGS

A. Steel Pipe: ASTM A53/A53M, black steel, Schedule 40, Type E or S, Grade B.

1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
2. Wrought-Steel Welding Fittings: ASTM A234/A234M for butt welding and socket welding.
3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

a. Material Group: 1.1.
b. End Connections: Threaded or butt welding to match pipe.

c. Lapped Face: Not permitted underground.
d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum O-rings, and spiral-wound metal gaskets.
e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.

5. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.

a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.

6. Mechanical Couplings:

a. Manufacturers: Subject to compliance with requirements, provide products by the following:

1)
2) Smith-Blair, a Xylem brand.
3) Dresser Piping Specialties, Division of Dresser, Inc.

b. Stainless steel flanges and tube with epoxy finish.
c. NBR seals.
d. Stainless steel bolts, washers, and nuts.
e. Coupling is to be capable of joining PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
f. Steel body couplings installed underground on plastic pipe are to be factory equipped with anode.

2.4 PIPING SPECIALTIES

A. Appliance Flexible Connectors:

1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
4. Corrugated, stainless steel tubing with polymer coating.
5. Operating-Pressure Rating: 0.5 psig.
6. End Fittings: Zinc-coated steel.
7. Threaded Ends: Comply with ASME B1.20.1.
8. Maximum Length: 72 inches.

B. Quick-Disconnect Devices: Comply with ANSI Z21.41.

1. Copper-alloy convenience outlet and matching plug connector.
2. Seals: Nitrile.
3. Hand operated with automatic shutoff when disconnected.
4. For indoor or outdoor applications.
5. Adjustable, retractable restraining cable.

C. Y-Pattern Strainers:

1. Body: ASTM A126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.

3. Strainer Screen: 60-mesh startup strainer, and perforated stainless steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

D. Weatherproof Vent Cap:

1. Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.5 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.

B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

2.6 MANUAL GAS SHUTOFF VALVES

A. General Requirements for Metallic Valves, NPS 2 (DN 50) and Smaller: Comply with ASME B16.33.

1. CWP Rating: 125 psig.
2. Threaded Ends: Comply with ASME B1.20.1.
3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
4. Tamperproof Feature: Locking feature for valves indicated in "Underground, Manual Gas Shutoff Valve Schedule" and "Aboveground, Manual Gas Shutoff Valve Schedule" articles.
5. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
6. Service Mark: Valves NPS 1-1/4 to NPS 2 having initials "WOG" permanently marked on valve body.

B. General Requirements for Metallic Valves, NPS 2-1/2 (DN 65) and Larger: Comply with ASME B16.38.

1. CWP Rating: 125 psig.
2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
3. Tamperproof Feature: Locking feature for valves indicated in "Underground, Manual Gas Shutoff Valve Schedule" and "Aboveground, Manual Gas Shutoff Valve Schedule" articles.
4. Service Mark: Initials "WOG" permanently marked on valve body.

C. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. A.Y. McDonald Mfg. Co.
b. Apollo Valves; a part of Aalberts Integrated Piping Systems

c. BrassCraft Manufacturing Co.; a Masco company
d. Perfection Corporation
e. R.W. Lyall; brand of Hubbell Utility Solutions; Hubbell Incorporated

2. Body: Bronze, complying with ASTM B584.
3. Ball: Chrome-plated bronze.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Packing: Threaded-body packnut design with adjustable-stem packing.
7. Ends: Threaded, flared, or socket as indicated in "Underground, Manual Gas Shutoff Valve Schedule" and "Aboveground, Manual Gas Shutoff Valve Schedule" articles.
8. CWP Rating: 600 psig.
9. Listing: Valves NPS 1 and smaller are to be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

2.7 EARTHQUAKE VALVES

A. Earthquake Valves, Maximum Operating Pressure of 5 psig (34.5 kPa): Comply with ASCE/SEI 25.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Vanguard Valves, Inc.

2. Listed and labeled by an NRTL acceptable to authorities having jurisdiction.
3. Maximum Operating Pressure: 5 psig.
4. Cast-aluminum body with nickel-plated chrome steel internal parts.
5. NBR valve washer.
6. Sight windows for visual indication of valve position.
7. Threaded end connections complying with ASME B1.20.1.
8. Wall-mounting bracket with bubble level indicator.

B. Earthquake Valves, Maximum Operating Pressure of 60 psig (414 kPa): Comply with ASCE/SEI 25.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Pacific Seismic Products, Inc

2. Listed and labeled by an NRTL acceptable to authorities having jurisdiction.
3. Maximum Operating Pressure: 60 psig.
4. Cast-aluminum body with stainless steel internal parts.
5. NBR, reset-stem O-ring seal.
6. Valve position, open or closed, indicator.
7. Composition valve seat with clapper held by spring or magnet locking mechanism.
8. Level indicator.
9. End Connections: Threaded for valves NPS 2 and smaller; flanged for valves NPS 2-1/2 and larger.

2.8 PRESSURE REGULATORS

A. General Requirements:

1. Single stage and suitable for natural gas.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 and smaller; flanged for regulators NPS 2-1/2 and larger.

B. Service Pressure Regulators: Comply with ANSI Z21.80A.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Actaris: a brand of ITT Controls
    b. American Meter Company
    c. Fischer; Emerson Electric Co., Automation Solutions
    d. Itron Inc.
    e. Richards Industrials
    f. Schneider Electric USA, Inc.

2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: NBR; resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Seal Plug: UV-stabilized, mineral-filled nylon.
8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to regulator.
9. Pressure regulator is to maintain discharge pressure setting downstream and is to not exceed 150 percent of design discharge pressure at shutoff.
10. Overpressure Protection Device: Factory mounted on pressure regulator.
11. Atmospheric Vent: Factory- or field-installed, stainless steel screen in opening if not connected to vent piping.
12. Maximum Inlet Pressure: 100 psig.

C. Line Pressure Regulators: Comply with ANSI Z21.80A.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. American Meter Company
    b. Carremm Controls
    c. Fischer; Emerson Electric Co., Automation Solutions
    d. Maxitrol Company

2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: NBR; resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Seal Plug: UV-stabilized, mineral-filled nylon.
8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to regulator.

9. Pressure regulator is to maintain discharge pressure setting downstream and is to not exceed 150 percent of design discharge pressure at shutoff.
10. Overpressure Protection Device: Factory mounted on pressure regulator.
11. Atmospheric Vent: Factory- or field-installed, stainless steel screen in opening if not connected to vent piping.
12. Maximum Inlet Pressure: 5 psig.

D. Boiler Line Pressure Regulators: Comply with ANSI Z21.80A.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Itron Inc., #B34SR, no exceptions.

2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: One-piece molded Buna-N.
6. Orifice: Brass; interchangeable.
7. Seal Cap: Die cast aluminum.
8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to regulator.
9. Pressure regulator is to maintain discharge pressure setting downstream and is to not exceed 150 percent of design discharge pressure at shutoff.
10. Overpressure Protection Device: Factory mounted on pressure regulator.
11. Atmospheric Vent: Factory- or field-installed, stainless steel screen in opening if not connected to vent piping.
12. Maximum Inlet Pressure: 5 psig.

E. Appliance Pressure Regulators: Comply with ANSI Z21.18.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Canadian Meter Company, LLC; a Honeywell Company
    b. Eaton
    c. Harper Wyman Co
    d. Maxitrol Company

2. Body and Diaphragm Case: Die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: NBR.
6. Seal Plug: UV-stabilized, mineral-filled nylon.
7. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
8. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
9. Maximum Inlet Pressure: 1 psig.

2.9 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. WATTS; A Watts Water Technologies Company
b. Wilkins

2. Description:

a. Standard: ASSE 1079.
b. Pressure Rating: 150 psig minimum at 180 deg F.
c. End Connections: Solder-joint copper alloy and threaded ferrous.

2.10 LABELING AND IDENTIFYING

A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description and rated pressure of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

B. Label and identify gas piping and pressure outside a multitenant building by tenant.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Close equipment shutoff valves before turning off natural gas to premises or piping section.

B. Inspect natural-gas piping in accordance with NFPA 54 to determine that natural-gas utilization devices are turned off in piping section affected.

C. Comply with NFPA 54 requirements for preventing accidental ignition.

3.3 INSTALLATION OF OUTDOOR PIPING

A. Comply with NFPA 54 for installation and purging of natural-gas piping.

B. Install underground, natural-gas piping buried at least 36 inches below finished grade. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

1. If natural-gas piping is installed less than 36 inches below finished grade, install it in

containment conduit.

C. Install underground, PE, natural-gas piping in accordance with ASTM D2774.

D. Steel Piping with Protective Coating:

1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
3. Replace pipe having damaged PE coating with new pipe.

E. Copper Tubing with Protective Coating:

1. Apply joint cover kits over tubing to cover, seal, and protect joints.
2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.

F. Install fittings for changes in direction and branch connections.

G. Install pressure gaugeupstream and downstream from each service regulator. Pressure gauges are specified in Section 230500 "Common Work Results for HVAC."

3.4 INSTALLATION OF INDOOR PIPING

A. Comply with NFPA 54 for installation and purging of natural-gas piping.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.

D. Do not install piping in concealed locations unless sleeved with the sleeve open at both ends.

E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

F. Where installing piping above accessible ceilings, allow sufficient space for ceiling panel removal.

G. Locate valves for easy access. Do not locate valves within return air plenums.

H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.

I. Install piping free of sags and bends.

J. Install fittings for changes in direction and branch connections.

K. Verify final equipment locations for roughing-in.

L. Comply with requirements in Sections specifying gas-fired appliances and equipment for

roughing-in requirements.

M. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.

1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.
2. Install sediment trap on both sides of regulators for gas reduction to 2 psig with valve and cap.

N. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.

O. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.

P. Concealed Location Installations: Except as specified below, install concealed natural-gas piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.

1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.
2. In Floors: Install natural-gas piping with welded or brazed joints and protective coating in cast-in-place concrete floors. Cover piping to be cast in concrete slabs with minimum of 1-1/2 inches of concrete. Piping may not be in physical contact with other metallic structures such as reinforcing rods or electrically neutral conductors. Do not embed piping in concrete slabs containing quick-set additives or cinder aggregate.
3. In Floor Channels: Install natural-gas piping in floor channels. Channels must have cover and be open to space above cover for ventilation.
4. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.

    a. Exception: Tubing passing through partitions or walls does not require striker barriers.

5. Prohibited Locations:

    a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
    b. Do not install natural-gas piping in solid walls or partitions.

Q. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

R. Connect branch piping from top or side of horizontal piping.

S. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.

T. Do not use natural-gas piping as grounding electrode.

U. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.

V. Install pressure gaugeupstream and downstream from each line regulator. Pressure gauges are specified in Section 230500 "Common Work Results for HVAC."

W. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230500 "Common Work Results for HVAC."

X. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230500 "Common Work Results for HVAC."

Y. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230500 "Common Work Results for HVAC."

3.5 INSTALLATION OF SERVICE-METER ASSEMBLIES

A. Install service-meter assemblies aboveground, on concrete bases.

B. Install metal shutoff valves upstream from service regulators. Shutoff valves are not required at second regulators if two regulators are installed in series.

C. Install strainer on inlet of service-pressure regulator and meter set.

D. Install service regulators mounted outside with vent outlet horizontal or facing down. Install screen in vent outlet if not integral with service regulator.

E. Install metal shutoff valves upstream from service meters. Install dielectric fittings downstream from service meters.

F. Install service meters downstream from pressure regulators.

G. Install metal bollards to protect meter assemblies. Comply with requirements in Section 055000 "Metal Fabrications" for pipe bollards.

3.6 INSTALLATION OF VALVES

A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless steel tubing, aluminum, or copper connector.

B. Install underground valves with valve boxes.

C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

D. Install earthquake valves aboveground outside buildings according to listing.

E. Install anode for metallic valves in underground PE piping.

F. Do not install valves in return-air plenums.

3.7 PIPING JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints:

1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
2. Cut threads full and clean using sharp dies.
3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Welded Joints:

1. Construct joints in accordance with AWS D10.12/D10.12M, using qualified processes and welding operators.
2. Bevel plain ends of steel pipe.
3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

E. Brazed Joints: Construct joints in accordance with AWS's "Brazing Handbook," "Pipe and Tube" Chapter.

F. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.

G. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, and then use wrench. Do not overtighten.

H. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join in accordance with ASTM D2657.

1. Plain-End Pipe and Fittings: Use butt fusion.
2. Plain-End Pipe and Socket Fittings: Use socket fusion.

3.8 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for seismic-restraint devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

B. Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hangers, supports, and anchor devices.

C. Install hangers for steel piping and copper tubing, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

D. Install hangers for corrugated stainless steel tubing, with maximum horizontal spacing and

minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

E. Support horizontal piping within 12 inches of each fitting.

F. Support vertical runs of steel piping and copper tubing to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

G. Support vertical runs of corrugated stainless steel tubing to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.9 PIPING CONNECTIONS

A. Connect to utility's gas main according to utility's procedures and requirements.

B. Install natural-gas piping electrically continuous, and bonded to gas-appliance equipment grounding conductor of the circuit powering the appliance in accordance with NFPA 70.

C. Where installing piping adjacent to appliances, allow space for service and maintenance of appliances.

D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.

3.10 LABELING AND IDENTIFICATION

A. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for piping and valve identification.

B. Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.11 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Test, inspect, and purge natural gas in accordance with NFPA 54 and authorities having jurisdiction.
2. Natural-gas piping will be considered defective if it does not pass tests and inspections.

B. Prepare test and inspection reports.

3.12 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain earthquake valves.

3.13 OUTDOOR PIPING SCHEDULE

A. Underground natural-gas piping is to be one of the following:

1. PE pipe and fittings joined by heat fusion, or mechanical couplings; service-line risers with tracer wire terminated in an accessible location.

B. Aboveground natural-gas piping is to be the following:

1. Steel pipe with malleable-iron fittings and threaded joints.

3.14 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG (3.45 kPa)

A. Aboveground, branch piping NPS 1 and smaller is to be the following:

1. Steel pipe with malleable-iron fittings and threaded joints.

B. Aboveground, distribution piping is to be the following:

1. Steel pipe with malleable-iron fittings and threaded joints.

C. Underground, below building, piping is to be[one of] the following:

1. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground portion of vent pipe and fittings with protective coating for steel piping.

3.15 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES MORE THAN 0.5 PSIG (3.45 kPa) AND LESS THAN 5 PSIG (34.5 kPa)

A. Aboveground, branch piping NPS 1 and smaller is to be the following:

1. Steel pipe with malleable-iron fittings and threaded joints.

B. Aboveground, distribution piping is to be the following:

1. Steel pipe with malleable-iron fittings and threaded joints.

C. Underground, below building, piping is to be[one of] the following:

1. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground portion of vent pipe and fittings with protective coating for steel piping.

3.16 ABOVEGROUND, MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Valves for pipe sizes NPS 2 and smaller at service meter are to be the following:

1. One-piece, bronze ball valve with bronze trim.
2. Bronze plug valve.

B. Valves for pipe sizes NPS 2-1/2 and larger at service meter are to be[one of] the following:

1. Bronze plug valve.
2. Cast-iron, nonlubricated plug valve.

END OF SECTION 23 1123

SECTION 23 2113

HYDRONIC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper tube and fittings.
2. Steel pipe and fittings.
3. Piping joining materials.
4. Transition fittings.
5. Dielectric fittings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of the following:

1. Pipe and tube.
2. Fittings.
3. Joining materials.
4. Transition fittings.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Piping layout, or BIM model, drawn to scale, indicating the items described in this Section, and coordinated with all building trades.

B. Qualification Data: For Installer.

C. Welding certificates.

1.4 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installers of Pressure-Sealed Joints: Installers are to be certified by pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.
2. Fiberglass Pipe and Fitting Installers: Installers of RTRF and RTRP are to be certified by manufacturer of pipes and fittings as having been trained and qualified to join fiberglass piping with manufacturer-recommended adhesive.

B. Steel Support Welding: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.

C. Pipe Welding: Qualify procedures and operators in accordance with ASME Boiler and Pressure Vessel Code: Section IX.

1. Comply with ASME B31.9 for materials, products, and installation.
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation are to be capable of withstanding the following minimum working pressures and temperatures unless otherwise indicated:

1. Hot-Water Heating Piping: 100 psig at 200 deg F.
2. Chilled-Water Piping: 150 psig at 73 deg F.
3. Condenser-Water Piping: 150 psig at 73 deg F.
4. Condensate-Drain Piping: 150 deg F.
5. Air-Vent Piping: 180 deg F.
6. Pressure-Relief-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

2.2 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tube: ASTM B88, Type L.

B. Annealed-Temper Copper Tube: ASTM B88, Type L.

C. DWV Copper Tube: ASTM B306, Type DWV.

D. Cast-Copper, Solder-Joint Fittings: ASME B16.18 pressure fittings. Do not use solder joints on pipe sizes greater than NPS 4.

E. Wrought-Copper, Solder-Joint Fittings: ASME B16.22 pressure fittings. Do not use solder joints on pipe sizes greater than NPS 4.

F. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends. Do not use solder joints on pipe sizes greater than NPS 4.

G. Cast-Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends. Do not use solder joints on pipe sizes greater than NPS 4.

H. Wrought-Copper Unions: ASME B16.22. Do not use solder joints on pipe sizes greater than NPS 4.

I. Copper-Tube, Mechanically Formed Tee Fitting: For forming T-branch on copper water tube.
1. Description: Tee formed in copper tube in accordance with ASTM F2014.

2.3 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A53/A53M black steel with plain ends; welded and seamless, Grade B, and schedule number as indicated in Part 3,"Piping Applications" Article.

B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in Part 3, "Piping Applications" Article.

C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in Part 3, "Piping Applications" Article.

D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in Part 3, "Piping Applications" Article.

E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in "Piping Applications" Article.

F. Wrought-Steel Fittings: ASTM A234/A234M; wall thickness to match adjoining pipe.

G. Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

1. Material Group: 1.1.
2. End Connections: Butt welding.
3. Facings: Raised face.

H. Grooved Mechanical-Joint Fittings and Couplings:
1. Source Limitations: Obtain grooved mechanical-joint fittings and couplings from single manufacturer.
2. Joint Fittings: ASTM A536, Grade 65-45-12 ductile iron; ASTM A47/A47M, Grade 32510 malleable iron; ASTM A53/A53M, Type F, E, or S, Grade B fabricated steel; or ASTM A106/A106M, Grade B steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
3. Couplings: Ductile- or malleable-iron housing and EPDM or nitrile gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

I. Steel Pipe Nipples: ASTM A733, made of same materials and wall thicknesses as pipe in which they are installed.

2.4 TRANSITION FITTINGS

A. General Requirements:

1. Same size as pipes to be joined.
2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

2.5 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:
   1. Source Limitations: Obtain dielectric unions from single manufacturer.
   2. Description:

      a. Standard: ASSE 1079.
      b. Pressure Rating: 125 psig minimum at 180 deg F.
      c. End Connections: Solder-joint copper alloy and threaded ferrous. Solder joints are not to be used on pipe sizes greater than NPS 4.

C. Dielectric-Flange Insulating Kits:
   1. Source Limitations: Obtain dielectric-flange insulating kits from single manufacturer.
   2. Description:

      a. Nonconducting materials for field assembly of companion flanges.
      b. Pressure Rating: 150 psig.
      c. Gasket: Neoprene or phenolic.
      d. Bolt Sleeves: Phenolic or polyethylene.
      e. Washers: Phenolic with steel backing washers.

D. Dielectric Nipples:
   1. Source Limitations: Obtain dielectric nipples from single manufacturer.
   2. Description:

      a. Standard: IAPMO PS 66.
      b. Electroplated steel nipple, complying with ASTM F1545.
      c. Pressure Rating: Minimum 300 psig at 225 deg F.
      d. End Connections: Male threaded or grooved.
      e. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Hot-Water Heating Piping, Aboveground, NPS 2 (DN 50) and Smaller, to Be Any of the Following:

   1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
   2. Schedule 40, Grade B, steel pipe; Class 125, cast-iron fittings; and threaded joints.

B. Hot-Water Heating Piping, Aboveground, NPS 2-1/2 (DN 65) and Larger, to Be Any of the Following:

   1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
   2. Schedule 40, Grade B, steel pipe; Class 125, cast-iron fittings; welded joints, cast-iron flanges, flange-fittings, and flanged joints.
   3. Schedule 40, Grade B, steel pipe; grooved mechanical joint coupling and fittings; and **grooved mechanical joints.**

C. Makeup-Water Piping Installed Aboveground to Be Any of the Following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

D. Condensate-Drain Piping Installed Aboveground to Be Any of the Following:

1. Type L Type DWV, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

E. Air-Vent Piping:

1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems, according to piping manufacturer's written instructions.
2. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.

F. Pressure-Relief-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed, with metal-to-plastic transition fittings for plastic piping systems, according to piping manufacturer's written instructions.

3.2 INSTALLATION OF PIPING

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Select system components with pressure rating equal to or greater than system operating pressure.

K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

O. Install branch connections to mains using mechanically formed tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.

P. Install air vents and pressure-relief valves in accordance with Section 232116 "Hydronic Piping Specialties."

Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

S. Install shutoff valve immediately upstream of each dielectric fitting.

T. Comply with requirements in Section 230500 "Common Work Results for HVAC" for installation of expansion loops, expansion joints, anchors, and pipe alignment guides.

U. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for identifying piping.

V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230500 "Common Work Results for HVAC."

W. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230500 "Common Work Results for HVAC."

X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230500 "Common Work Results for HVAC."

3.3 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Soldered Joints: Apply ASTM B813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints in accordance with ASTM B828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B32.

D. Brazed Joints: Construct joints in accordance with AWS's "Brazing Handbook," "Pipe and Tube" chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8/A5.8M.

E. Threaded Joints: Thread pipe with tapered pipe threads in accordance with ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

F. Welded Joints: Construct joints in accordance with AWS D10.12M/D10.12, using qualified processes and welding operators in accordance with "Quality Assurance" Article.

G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

H. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings in accordance with the following:

1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.
2. CPVC Piping: Join in accordance with ASTM D2846/D2846M Appendix.
3. PVC Pressure Piping: Join ASTM D1785 schedule number, PVC pipe, and PVC socket fittings in accordance with ASTM D2672. Join other-than-schedule-number PVC pipe and socket fittings in accordance with ASTM D2855.
4. PVC Non pressure Piping: Join in accordance with ASTM D2855.

I. Fiberglass-Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

J. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.

K. Plain-End Mechanical-Coupled Joints: Prepare, assemble, and test joints in accordance with manufacturer's written installation instructions.

L. Mechanically Formed Tee Fittings: Use manufacturer-recommended tools, procedure, and brazed joints.

M. Pressure-Seal Joints: Use manufacturer-recommended tools and procedure. Leave insertion marks on pipe after assembly.

3.4 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for seismic-restraint devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

B. Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hangers, supports, and anchor devices.

C. Install hangers for copper tubing and steel piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

D. Install hangers for plastic piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

E. Install hangers for fiberglass piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

F. Support horizontal piping within 12 inches of each fitting and coupling.

G. Support vertical runs of copper tubing and steel piping to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

H. Support vertical runs of fiberglass piping to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.5 TERMINAL EQUIPMENT CONNECTIONS

A. Sizes for supply and return piping connections are to be the same as or larger than equipment connections.

B. Install control valves in accessible locations close to connected equipment.

C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.

D. Install ports for pressure gauges and thermometers at coil inlet and outlet connections. Comply with requirements in Section 230500 "Common Work Results for HVAC."

3.6 CHEMICAL TREATMENT

A. System Flushing and Fill:
   1. The mechanical contractor is responsible for flushing, clean and fill the closed loop hydronic system as noted below. In addition, the mechanical contractor is responsible to coordinate the testing of the fill water and to install chemical additions provided by LTF's water treatment contractor, International Chemtex (contact Ron Phares 651-968-7768) prior to starting the boiler system.

B. Chemical Flushing:
   1. The system cleaner shall be 9320 by Internation Chemtex or approved equal.
   2. Drain the system after the required circulation period as quickly as possible, this will prevent settling of foulants. Run circulation pumps and flush with clean water until the discharge water is clear.
   3. When system water is clear, remove, clean and replace all strainers.

3.7 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Section 230553 "Identification for HVAC Piping and Equipment."

3.8 SYSTEM STARTUP

A. Perform the following before operating the system:

1. Open manual valves fully.
2. Inspect pumps for proper rotation.
3. Set makeup pressure-reducing valves for required system pressure.
4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
7. Verify lubrication of motors and bearings.

3.9 FIELD QUALITY CONTROL

A. Prepare hydronic piping in accordance with ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure is to be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
5. Install pressure-relief valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:

1. Use ambient-temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
3. Isolate expansion tanks and determine that hydronic system is full of water.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure is not to exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times the "SE" value in Appendix A in ASME B31.9.
5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
6. Prepare written report of testing.

END OF SECTION 23 2113

SECTION 23 2116

HYDRONIC PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Hydronic specialty valves.
2. Air vents.
3. Expansion tanks and fittings.
4. Air separators.
5. Strainers.
6. Flexible connectors.

B. Related Requirements:

1. Section 230500 "Common Work Results for HVAC" for expansion fittings and loops.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product:

1. Include construction details and material descriptions for hydronic piping specialties.
2. Include rated capacities, operating characteristics, and furnished specialties and accessories.
3. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For hydronic piping specialties to include in emergency, operation, and maintenance manuals.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Differential Pressure Meter: For each type of balancing valve and automatic flow control valve, include flowmeter, probes, hoses, flow charts, and carrying case.

1.5 QUALITY ASSURANCE

A. Pipe Welding: Qualify procedures and operators in accordance with ASME BPVC, Section IX.

B. Pressure-relief and safety-relief valves and pressure vessels bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME BPVC, Section VIII, Division 1.

PART 2 - PRODUCTS

2.1 HYDRONIC SPECIALTY VALVES

A. Diaphragm-Operated, Pressure-Reducing Valves: ASME labeled.
   1. Manufacturers: Subject ot compliance with requirements, provide products by one of the following:
      a. Conbraco Industries Inc.
      b. Spence Engineering Company, Inc.
      c. Watts Regulator Co.; a division of w=Watts Water Technologies, Inc.
   2. Body: Bronze or brass.
   3. Disc: Glass and carbon-filled PTFE.
   4. Seat: Brass.
   5. Stem Seals: EPDM O-rings.
   6. Diaphragm: EPT.
   7. Low inlet-pressure check valve.
   8. Inlet Strainer: Stainless steel, removable without system shutdown.
   9. Valve Seat and Stem: Noncorrosive.
   10. Valve Size and Capacity: As indicated on Drawings.
   11. Operating Pressure: Factory set and field adjustable.

B. Diaphragm-Operated Pressure-Relief Valves: ASME labeled.
   1. Manufacturers: Subject ot compliance with requirements, provide products by one of the following:
      a. Conbraco Industries Inc.
      b. Spence Engineering Company, Inc.
      c. Watts Regulator Co.; a division of w=Watts Water Technologies, Inc.
   2. Body: Bronze or brass.
   3. Disc: Glass and carbon-filled PTFE.
   4. Seat: Brass.
   5. Stem Seals: EPDM O-rings.
   6. Diaphragm: EPT.
   7. Valve Seat and Stem: Noncorrosive.
   8. Valve Size, Capacity, and Operating Pressure: Comply with ASME BPVC, Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

C. Automatic Flow-Control Valves:
   1. Manufacturers: Subject ot compliance with requirements, provide products by one of the following:
      a. Nexus Valve
   2. Model UltraMatic UM
   3. Valve housings for units NPS 1-1/2" and smaller shall be forged brass, units NPS 2 - 2-1/2" shall be cast brass, rated at no less than 600 psi at 325°F.
   4. Valve housing shall include (2) 1/4" NPT pressure/temperature test ports, removable flow control cartridge, ball valve and union end with NPT threads.
   5. Flow Control Cartridge:
      a. The flow control cartridge shall be a single assembly constructed with stainless steel moving parts, and shall be accesible without removing the valve from the piping.
      b. The flow cartridge shall be factory flow tested and calibrated to maintain an accuracy of +/- 5%.
   6. Each unit shall be furnished with metal tag indicating model, flow rate and operating control range.

2.2 PRESSURE INDEPENDENT ACTUATED BALL VALVES

A. Pressure-Independent Ball Valves 6 inch and Smaller:
   1. Available Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Belimo.
   2. Control valves assemblies shall be provided and delivered from a single manufacturer as a complete assembly.
   3. Warranty:
      a. The manufacturer shall warrant all components for a period of 5 years from the date of production with the first two years unconditional.
   4. Pressure Rating for 2 inch and smaller: 360 psi.
   5. Pressure Rating for 2-1/2 inch through 6 inch: ANSI 125, Class B.
   6. Close-off pressure for 2 inch and smaller: 200 psi.
   7. Close-off pressure for 2-1/2 inch through 6 inch: 100 psi.
   8. Process Temperature Range: Between 14 °F to 250 F .
   9. Body: 2 inch and smaller Forged brass, nickel plated with NPT female ends.
   10. Body: 2-1/2 inch through 6-inch Cast iron with pattern to mate with ANSI 125 flange.
   11. Ball: Stainless steel.
   12. Stem and Stem Extension: Stainless steel, blowout-proof design.
   13. Ball Seats: Teflon PTFE.
   14. Stem Seal: Dual EPDM O-rings (lubricated).
   15. Flow Characteristic: Equal percentage.

B. Pressure-Independent ANSI 250 Globe Valves 2-1/2 through NPS 6:
   1. Available Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Belimo.
   2. Control valves assemblies shall be provided and delivered from a single manufacturer as a complete assembly.
   3. Warranty:
      a. The manufacturer shall warrant all components for a period of 5 years from the date of production with the first two years unconditional.
   4. Pressure Rating: ANSI 250.
   5. Close-off pressure: 100 psi.
   6. Process Temperature Range: Between 14 deg F to 250 deg F.
   7. Globe Style: Single port.
   8. Body: Cast iron.
   9. End Connections: ANSI 250.
   10. Packing: EPDM NLP.
   11. Plug, Seat, and Stem: Stainless steel.
   12. Leakage: ANSI Class IV.
   13. Flow Characteristic: Equal percentage.

C. Control Actuators:
   1. Available Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Belimo.
   2. Description: Proportional electronic actuator.
   3. Applications: Controlled devices, as described herein.
   4. Supply Power Requirement: 24 VAC or 120 VAC.
   5. Motors: Synchronous type designed for long life and silent operation.
   6. Magnetic Clutch: For smooth torque delivery without calibration. Constant torque or end of travel.
   7. Shut-Off Force: As appropriate to shut off against maximum torque.
   8. Manual override: Provide lever to allow for manual operation.

9. Control Signal: 0 to 10 VDC (4 to 20 mA as approved).
    a. Floating point or PWM shall not be acceptable.
10. Spring Return: As required by application.
    a. Shut-Off Force: To close against 125% maximum required torque.

2.3 AIR VENTS

A. Manual Air Vents:
1. Body: Bronze.
2. Internal Parts: Nonferrous.
3. Operator: Screwdriver or thumbscrew.
4. Inlet Connection: NPS 1/2.
5. Discharge Connection: NPS 1/8.
6. CWP Rating: 150 psig.
7. Maximum Operating Temperature: 225 deg F.

2.4 EXPANSION TANKS AND FITTINGS

A. Bladder-Type ASME Expansion Tanks:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Taco, or approved equal.
2. Tank: Welded steel, rated for 125-psig (860-kPa) working pressure and 240 deg F (116 deg C) maximum operating temperature, with taps in top of tank for tank fitting and taps in side of tank for gage glass. Tanks shall be factory tested with taps fabricated and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
3. Bladder: Heavy duty butyl, replaceable.
4. Tank Drain Fitting: Brass body, nonferrous internal parts; 125-psig (860-kPa) working pressure and 240 deg F (116 deg C) maximum operating temperature; constructed to admit air to compression tank, drain water, and close off system.

2.5 AIR SEPARATORS

A. In-Line Air Separators:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Spirotherm, Inc, or approved equal.
2. Shell: One-piece steel with an integral weir constructed to decelerate system flow to maximize air separation.
3. Vent Head: Brass.
4. Float: Non-Ferrous.
5. Coalescing Medium: Copper.
6. Ball Valve: Brass.
7. Maximum Working Pressure: Up to 150 psig (1035 kPa).
8. Maximum Operating Temperature: Up to 270 deg F (132 deg C)..

2.6 STRAINERS

A. Y-Pattern Strainers:
1. Body: ASTM A126, Class B, cast iron with bolted cover and bottom drain connection.

2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: Stainless steel, 20-mesh strainer, or perforated stainless steel basket.
4. CWP Rating: 125 psig.

2.7 FLEXIBLE CONNECTORS

A. Stainless Steel Bellows, Flexible Connectors:
1. Body: Stainless steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket.
2. End Connections: Threaded or flanged to match equipment connected.
3. Performance: Capable of 3/4-inch misalignment.
4. CWP Rating: 150 psig.
5. Maximum Operating Temperature: 250 deg F.

2.8 CHEMICAL TREATMENT

A. Bypass Chemical Feeder: Welded steel construction; 125-psig (860-kPa) working pressure; 5-gal. (18.9 liter) capacity; with fill funnel and inlet, outlet, and drain valves.
1. Chemicals: Specially formulated, based on analysis of makeup water, to prevent accumulation of scale and corrosion in piping and connected equipment.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine all piping specialties for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Examine threads on all devices for form and cleanliness.

C. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

D. Do not attempt to repair defective piping specialties; replace with new devices. Remove defective piping specialties from site.

3.2 INSTALLATION OF VALVES

A. Install calibrated-orifice balancing valve at each branch connection to return main.

B. Install calibrated-orifice, balancing valve in the return pipe of each heating or cooling terminal.

C. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

D. Install pressure-relief and safety-relief valves at hot-water generators and elsewhere as required by ASME BPVC. Pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME BPVC, Section VIII, Division 1, for installation requirements.

3.3 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

B. Install automatic air vents at high points of system piping in mechanical equipment rooms only.

1. Provide air outlet drain line full size of air outlet to floor drain or to other point indicated on Drawings.

C. Install manual vents at heat-transfer coils and elsewhere as required for air venting.

D. Install in-line air separators in pump suction. Install drain valve on air separators NPS 2 and larger.

E. Install tangential air separator in pump suction. Install blowdown piping with gate or full-port ball valve full size of separator outlet; extend full size to nearest floor drain.

F. Install expansion tanks having direct air/water interface above the air separator or air purger. Install tank fitting in tank bottom and charge tank. Use manual vent for initial fill to establish proper water level in tank.

1. Install tank fittings that are shipped loose.
2. Support tank from floor or structure above with sufficient strength to carry weight of tank, piping connections, and fittings, plus tank full of water. Do not overload building components and structural members.
3. Install piping from air separator or air purger to expansion tank with a 2 percent upward slope toward tank to avoid air entrapment.

G. Install diaphragm- or bladder-type expansion tanks on the floor.

H. Vent and purge air from hydronic system, and ensure that tank is properly charged with air to suit system Project requirements.

END OF SECTION 23 2116

SECTION 23 2123

HYDRONIC PUMPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Close-coupled, in-line centrifugal pumps.
2. Close-coupled, end-suction centrifugal pumps.

1.2 DEFINITIONS

A. ECM: Electronically commutated motor.

B. EPDM: Ethylene propylene diene monomer.

C. EPR: Ethylene propylene rubber.

D. FKM: Fluoroelastomer polymer.

E. HI: Hydraulic Institute.

F. NBR: Nitrile rubber or Buna-N.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of pump.

1. Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated.
2. Indicate pump's operating point on curves.

B. Shop Drawings: For each pump.

1. Show pump layout and connections.
2. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.
3. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.

B. Seismic Qualification Data: Certificates for pumps, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Mechanical Seals: One mechanical seal(s) for each pump.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Seismic Performance: Pumps shall withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
2. Component Importance Factor: 1.0.

2.2 CLOSE-COUPLED, IN-LINE CENTRIFUGAL PUMPS

A. Source Limitations: Obtain pumps from single source from single manufacturer.

B. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally or vertically.

C. Pump Construction:

1. Casing: Radially split, cast iron, with threaded gauge tappings at inlet and outlet, replaceable bronze wear rings, and threaded companion-flange connections.

2. Impeller: ASTM B584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For constant-speed pumps, trim impeller to match specified performance.
3. Pump Shaft Sleeve: Bronze.
4. Seal: Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless steel spring, and NBR rubber bellows and gasket. Include water slinger on shaft between motor and seal.

D. Motor: Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230500 "Common Work Results for HVAC."

1. Enclosure : Totally enclosed, fan cooled.
2. NEMA Premium Efficient motors as defined in NEMA MG 1.
3. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
4. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
5. Single or Variable-speed motor.
6. Provide integral pump motor variable-speed controller.

2.3 CLOSE-COUPLED, END-SUCTION CENTRIFUGAL PUMPS

A. Source Limitations: Obtain pumps from single source from single manufacturer.

B. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, end-suction pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally.

C. Pump Construction:

1. Casing: Radially split, cast iron, with drain plug at bottom and air vent at top of volute, threaded gauge tappings at inlet and outlet, and threaded companion-flange connections.
2. Impeller: ASTM B584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For constant-speed pumps, trim impeller to match specified performance.
3. Pump Shaft Sleeve: Steel, with bronze-alloy shaft sleeve.
4. Seal: Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless steel spring, and NBR bellows and gasket. Include water slinger on shaft between motor and seal.
5. Pump Bearings: Permanently lubricated ball bearings.
6.

D. Motor: Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230500 "Common Work Results for HVAC."

1. Enclosure: Totally enclosed, fan cooled.
2. NEMA Premium Efficient motors as defined in NEMA MG 1.
3. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
4. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
5. Single or Variable-speed motor.
6. Provide integral pump motor variable-speed controller.

2.4 PUMP SPECIALTY FITTINGS

A. Suction Diffuser:

1. Angle pattern.
2. 175-psig pressure rating, cast-iron body and end cap, pump-inlet fitting.
3. Bronze 16-mesh wire startup and bronze or Type 304 stainless steel permanent strainers with 3/16-inch.
4. Bronze Type 304 stainless steel straightening vanes.
5. Drain plug.
6. Factory-fabricated support.

B. 3-Port Trumpet Valve

1. The heating/boiler contractor shall furnish and install a 3-port trumpet valve on each pump. Trumpet valve shall be Flow Conditioning Corporation #TV-3 or equal and approved. Install a Weiss #TL35P, pressure gauge 3-1/2” diameter with graduation 0-60 psi at main pumps in the boiler room.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.

C. Examine foundations and inertia bases for suitable conditions where pumps will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PUMP INSTALLATION

A. Comply with HI 1.4 and HI 2.4.

B. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories.

C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.

D. Automatic Condensate Pump Units: Install units for collecting condensate and extend to open drain.

E. Equipment Mounting:

1. Install base-mounted pumps on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
2. Comply with requirements for vibration isolation and seismic-control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

3. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

F. Equipment Mounting for In-Line Pumps Suspended from Structure: Install in-line pumps with continuous-thread hanger rods and spring hangers of size required to support weight of in-line pumps.

1. Comply with requirements for seismic-restraint devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
2. Comply with requirements for hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

3.3 ALIGNMENT

A. Engage a factory-authorized service representative to perform alignment service.

B. Perform alignment service. When required by manufacturer to maintain warranty coverage, engage a factory-authorized service representative to perform it.

C. Comply with requirements in HI standards for alignment of pump and motor shaft. Add shims to the motor feet and bolt motor to base frame. Do not use grout between motor feet and base frame.

D. Comply with pump and coupling manufacturers' written instructions.

E. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.4 PIPING CONNECTIONS

A. Comply with requirements for piping specified in Section 232213 "Steam and Condensate Heating Piping" and Section 232216 "Steam and Condensate Piping Specialties." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to pump, allow space for service and maintenance.

C. Connect piping to pumps. Install valves that are same size as piping connected to pumps.

D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.

E. Install check, shutoff, and throttling valves on discharge side of pumps.

F. Install suction diffuser and shutoff valve on suction side of pumps.

1. Use startup strainer for initial system startup. Install permanent strainer element before turnover of system to Owner.

G. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.

H. Install pressure gauges on pump suction and discharge or at integral pressure-gauge tapping, or install single gauge with multiple-input selector valve.

I. Install check valve on each condensate pump unit discharge unless unit has a factory-installed check valve.

3.5 ELECTRICAL CONNECTIONS

A. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.

D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."
2. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

3.6 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring in accordance with Section 260523 "Control-Voltage Electrical Power Cables."

3.7 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks in accordance with manufacturer's written instructions.
2. Check piping connections for tightness.
3. Clean strainers on suction piping. Use startup strainer for initial startup.
4. Perform the following startup checks for each pump before starting:

    a. Verify bearing lubrication.
    b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
    c. Verify that pump is rotating in correct direction.

5. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
6. Start motor.
7. Open discharge valve slowly.

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections with the assistance of a factory-authorized service representative.

D. Hydronic pumps will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.9 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps.

END OF SECTION 23 2123

SECTION 23 3113

METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Double-wall rectangular ducts and fittings.
3. Single-wall round and flat-oval ducts and fittings.
4. Double-wall round and flat-oval ducts and fittings.
5. Sheet metal materials.
6. Aluminum duct
7. Duct liner.
8. Sealants and gaskets.
9. Hangers and supports.

B. Related Requirements:

1. Section 230548 "Vibration and Seismic Controls for HVAC" for seismic restraint devices and installation.
2. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
3. Section 233116 "Nonmetal Ducts" for fibrous-glass ducts, thermoset fiber-reinforced plastic ducts, thermoplastic ducts, PVC ducts, and concrete ducts.
4. Section 233119 "HVAC Casings" for factory- and field-fabricated casings for mechanical equipment.
5. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.
3. Seismic-restraint devices.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top and bottom of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.

8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: A single set of plans or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.

B. Welding certificates.

C. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
3. AWS D9.1/D9.1M, "Sheet Metal Welding Code," for duct joint and seam welding.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and with performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Structural Performance: Duct hangers and supports and seismic restraints are to withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and ASCE/SEI 7.

C. Seismic Performance: Ductwork to withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7. See Section 230548 "Vibration and Seismic Controls for HVAC."

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
2. Component Importance Factor: 1.0.

D. Airstream Surfaces: Surfaces in contact with airstream comply with requirements in ASHRAE 62.1.

E. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Startup."

F. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

G. Duct Dimensions: Unless otherwise indicated, all duct dimensions indicated on Drawings are inside clear dimensions and do not include insulation or duct wall thickness.

2.2 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

1. Construct ducts of galvanized sheet steel unless otherwise indicated.
2. For ducts exposed to weather, construct of Type 304 stainless steel indicated by manufacturer to be suitable for outdoor installation.

B. Transverse Joints: Fabricate joints in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. For ducts with longest side less than 36 inches, select joint types in accordance with Figure 2-1.
2. For ducts with longest side 36 inches or greater, use flange joint connector Type T-22, T-24, T-24A, T-25a, or T-25b. Factory-fabricated flanged duct connection system may be used if submitted and approved by engineer of record.

C. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible." All longitudinal seams are to be Pittsburgh lock seams unless otherwise specified for specific application.

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 DOUBLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. Manufacturers: Available manufacturers offering products that may be incorporated into the work include, but are not limited to the following:
1. Sheet Metal Connectors, Inc.
2. McGill AirFlow LLC.

B. Rectangular Ducts: Fabricate ducts with indicated dimensions for the inner duct.

C. Other Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

D. Transverse Joints: Companion Angles Flanges with gaskets must be used for all ducts connections with one (or more) dimension greater than 18”. Ducts with all dimensions 18” or less may have selected joints according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

E. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Longitudinal Seams - Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

F. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
   1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
   2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
   3. Cover Insulation with polyester film complying with UL 181, Class 1.

G. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C 534, Type II for sheet materials, and with NFPA 90A or NFPA 90B.
   1. Maximum Thermal Conductivity: 0.25 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.

H. Inner Duct: Minimum 0.028-inch solid aluminum sheet (NO EXCEPTIONS)
   1. Antimicrobial Coating: Shop-applied to interior solid wall below perforated material.

I. Formed-on Transverse Joints (Flanges): Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Traverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

J. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.4 SINGLE-WALL ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

   1. Construct ducts of galvanized sheet steel unless otherwise indicated.
   2. For ducts exposed to weather, construct of Type 304 stainless steel indicated by manufacturer to be suitable for outdoor installation.

B. Source Limitations: Obtain single-wall round and flat oval ducts and fittings from single manufacturer.

C. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).

D. Transverse Joints: Select joint types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

E. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

F. Tees and Laterals: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.5 DOUBLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

A. Manufactures: Available manufacturers offering products that may be incorporated into the work include, but are not limited to the following:
1. Sheet Metal Connectors, Inc.
2. McGill AirFlow LLC

B. Double-Wall Round Ducts: Fabricate ducts with indicated dimensions for the inner duct.

C. Other Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

D. Transverse Joints: Companion Angles Flanges with gaskets must be used for all ducts connections with diameter greater than 18”. Ducts with diameters 18” or less may selected joints according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Select joints types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3- 1, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

E. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

F. Tee and Laterals: Select types and fabricate according to SMACNA’s “HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

G. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
   1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
   2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
   3. Cover Insulation with polyester film complying with UL 181, Class 1.

H. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C 534, Type II for sheet materials, and with NFPA 90A or NFPA 90B.
   1. Maximum Thermal Conductivity: 0.25 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.

I. Inner Duct: Minimum 0.028-inch solid aluminum sheet steel (NO EXCEPTIONS)
   1. Antimicrobial Coating: Shop-applied to interior solid wall below perforated material.

2.6 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials are to be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A653/A653M.

   1. Galvanized Coating Designation: G90.
   2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Spiral Metal: Exposed above floor round and oval ductwork.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. United Sheet Metal Co.: Spiral UniSeal Duct or equal.
   2. Metal gauge:
      a. 3" dia. to 8" dia.:
         1) 26 gauge.
      b. 10" dia. to 14" dia.:
         1) 26 gauge.
      c. 16" dia. to 26" dia.:
         1) 24 gauge.
      d. 27" dia. to 36" dia.:
         1) 22 gauge.
      e. 37" dia. to 50" dia.:
         1) 20 gauge.
   3. Fittings: Continuous welds and in the following gauges:
      a. 3" dia. to 36" dia.:
         1) 20 gauge.
      b. 37" dia. to 50" dia.:
         1) 18 gauge.

D. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.

E. Aluminum Sheets: Comply with ASTM B 209 (ASTM B 209M) Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.
   1. Positive pressure:
      a. 3" dia. to 8" dia.:
         1) 0.032".
      b. 9" dia. to 14" dia.:
         1) 0.032"
      c. 15" dia. to 26" dia.:
         1) 0.032"
      d. 27" dia. to 36" dia.:
         1) 0.040"
   2. Negative pressure:
      a. 3" dia. to 8" dia.:
         1) .032"
      b. 9" dia. to 14" dia.:
         1) 0.032"
      c. 15" dia. to 26" dia.:
         1) 0.040"
      d. 27" dia. to 36" dia.:
         1) 0.050"

F. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

G. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

H. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

I. Tie Rods: Galvanized steel, 1/4-inch-minimum diameter for lengths 36 inches or less; 3/8-inch-minimum diameter for lengths longer than 36 inches.

2.7 DUCT LINER

A. Fibrous-Glass Duct Liner: Comply with ASTM C1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Johns Manville.
   2. Maximum Thermal Conductivity:
      a. Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.

   3. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound is to be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
   4. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C916.
   5. Products: Subject to compliance with requirements, provide the following:

a. Johns Manville; Permacote Linacoustic Standard HP or approved equal.

B. Insulation Pins and Washers:

1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized steel; with beveled edge sized as required to hold insulation securely in place, but not less than 1-1/2 inches in diameter.

C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."

1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
3. Butt transverse joints without gaps, and coat joint with adhesive.
4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm or greater.
7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:

    a. Fan discharges.
    b. Intervals of lined duct preceding unlined duct.
    c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.

9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.

    a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.

10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.8 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets are to be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.

B. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10 inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

C. Flanged Joint Sealant: Comply with ASTM C920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.

D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

E. Round Duct Joint O-Ring Seals:

1. Seal is to provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and is to be rated for10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.9 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Galvanized-steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A603.

E. Steel Cables for Stainless Steel Ducts: Stainless steel complying with ASTM A492.

F. Steel Cable End Connections: Galvanized-steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

H. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless Steel Ducts: Stainless steel shapes and plates.
3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and coordination drawings.

B. Install ducts in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install ducts in maximum practical lengths with fewest possible joints.

D. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

E. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

G. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

H. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

I. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

J. Install fire, combination fire/smoke, and smoke dampers where indicated on Drawings and as required by code, and by local authorities having jurisdiction. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers and specific installation requirements of the damper UL listing.

K. Install heating coils, cooling coils, air filters, dampers, and all other duct-mounted accessories in air ducts where indicated on Drawings.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials both before and after installation. Comply with SMACNA's "IAQ Guidelines for Occupied

Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

M. Elbows: Use long-radius elbows wherever they fit.

1. Fabricate 90-degree rectangular mitered elbows to include turning vanes.
2. Fabricate 90-degree round elbows with a minimum of three segments for 12 inches and smaller and a minimum of five segments for 14 inches and larger.

N. Branch Connections: Use lateral or conical branch connections.

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 ADDITIONAL INSTALLATION REQUIREMENTS FOR TYPE 1 COMMERCIAL KITCHEN GREASE HOOD EXHAUST DUCT

A. Install ducts in accordance with NFPA 96, "Ventilation Control and Fire Protection of Commercial Cooking Operation"; SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; and SMACNA's "Kitchen Ventilation Systems and Food Service Equipment Fabrication and Installation Guidelines" unless otherwise indicated.

B. Install all ducts without dips and traps that may hold grease, and sloped a minimum of 2 percent to drain grease back to the hood.

C. All ducts exposed to view are to be constructed of stainless steel as per "Duct Schedule" Article. All ducts concealed from view are to be stainless steel as per "Duct Schedule" Article.

D. All joints are to be welded and are to be telescoping, bell, or flange joint as per NFPA 96.

E. Install fire-rated access panel assemblies at each change in direction and at maximum intervals of 20 feet in horizontal ducts, and at every floor for vertical ducts, or as indicated on Drawings.

F. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.

3.4 ADDITIONAL INSTALLATION REQUIREMENTS FOR EXHAUST DUCTS SERVING COMMERCIAL DISHWASHERS AND OTHER HIGH-HUMIDITY LOCATIONS

A. Install dishwasher exhaust ducts and other exhaust ducts from wet, high-humidity locations without dips and traps that may hold water. Slope ducts a minimum of 2 percent back to dishwasher or toward drain.

B. Provide a drain pocket at each low point and at the base of each riser with a 1-inch trapped copper drain from each drain pocket to open site floor drain.

C. Minimize number of transverse seams.

D. Do not locate longitudinal seams on bottom of duct.

3.5 DUCTWORK EXPOSED TO WEATHER

A. All external joints are to be welded. Seal all openings to provide weatherproof construction.

B. Construct ductwork to resist external loads of wind, snow, ice, and other effects of weather. Provide necessary supporting structures.

C. Single Wall:

1. Ductwork is to be Type 304 stainless steel.
2. Ductwork is to be galvanized steel.

    a. If duct outer surface is uninsulated, protect outer surface with suitable paint. Paint materials and application requirements are specified in Section 099113 "Exterior Painting."

3. Where ducts have external insulation, provide weatherproof aluminum jacket. See Section 230713 "Duct Insulation."

D. Double Wall:

1. Ductwork complies with requirements in "Double-Wall Rectangular Ducts and Fittings" or "Double-Wall Round and Flat-Oval Ducts and Fittings" Article.
2. Ductwork outer wall is to be Type 304 stainless steel indicated by manufacturer to be suitable for outdoor installation.
3. Provide interstitial insulation.

3.6 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

B. Seal ducts at a minimum to the following seal classes in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":

1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
2. Outdoor, Supply-Air Ducts: Seal Class A.
3. Outdoor, Exhaust Ducts: Seal Class C.

4. Outdoor, Return-Air Ducts: Seal Class C.
5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
7. Unconditioned Space, Exhaust Ducts: Seal Class C.
8. Unconditioned Space, Return-Air Ducts: Seal Class B.
9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
11. Conditioned Space, Exhaust Ducts: Seal Class B.
12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.7 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints. Coordinate with Section 230548 "Vibration and Seismic Controls for HVAC."

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.8 SEISMIC-RESTRAINT-DEVICE INSTALLATION

A. See Section 230548 "Vibration and Seismic Controls for HVAC" for seismic restraint installation requirements.

3.9 DUCTWORK CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.10 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

3.11 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:

1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
2. Test the following systems:

    a. Ducts with a Pressure Class Higher Than 3-Inch wg: Test representative duct sections totaling no less than 25 percent of total installed duct area for each designated pressure class.
    b. Supply Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure class.
    c. Return Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure class.
    d. Exhaust Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure class.
    e. Outdoor-Air Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure class.

3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
4. Testing of each duct section is to be performed with access doors, coils, filters, dampers, and other duct-mounted devices in place as designed. No devices are to be removed or blanked off so as to reduce or prevent additional leakage.
5. Test for leaks before applying external insulation.
6. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
7. Give seven days' advance notice for testing.

C. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present.
2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness in accordance with "Description of Method 3 - NADCA Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."

    a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media is to not exceed 0.75 mg/100 sq. cm.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.12 DUCT CLEANING

A. Clean new duct system(s) before testing, adjusting, and balancing.

B. For cleaning of existing ductwork, see Section 230130.52 "Existing HVAC Air Distribution System Cleaning."

C. Use duct cleaning methodology as indicated in NADCA ACR.

D. Use service openings for entry and inspection.

1. Provide openings with access panels appropriate for duct static-pressure and leakage class at dampers, coils, and any other locations where required for inspection and cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 233300 "Air Duct Accessories" for access panels and doors.
2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling to gain access during the cleaning process.

E. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

F. Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components and makeup air systems.

G. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans in accordance with NADCA ACR. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents in accordance with manufacturer's written instructions after removal of surface deposits and debris.

3.13 STARTUP

A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.14 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

1. Fabricate all ducts to achieve SMACNA pressure class, seal class, and leakage class as indicated below.

B. Aluminum sheet:
1. Pool units (ERU-1, TF-1), Supply, Return and Exhaust.
2. Pool Equipment Room (RTU-3, EF-4), Supply, Return and Exhaust.
3. Locker Room Exhaust (ERU-2)
4. Dryer exhaust: Flanged and gasketed joints or pop riveted joints with no sheet metal screws extending into ductwork.
5. Dishwasher Exhast (EF-6): All seams shall be sealed waterright.

C. Intermediate Reinforcement: Match duct material.

D. All exterior ductwork shall be double wall with solid non-perforated aluminum inner liner and 75-mm (3”) R-12 insulation liner between duct walls. Exterior duct skin shall be aluminum with all joints sealed water tight.

E. Grease duct from kitchen hood to exhaust fan shall be 16 gauge welded class 1 grease duct with (2) 1-1/2" layers of 3M 615+ grease duct wrap for 2 hour shaft rating. Continue firewrap over top of hood as required per local codes. No dampers, turning vanes, or obstructions of any kind shall be in airstream. Contractor shall install code required access panels for cleaning duct at all elbows and where required by code.

F. All Supply ductwork from ERU-1 (outside of the pool area) shall be double wall with solid non-perforated aluminum inner duct and 2” R-8 insulation liner between duct walls. Exterior duct skin shall be aluminum with all joints sealed water tight. All Supply ductwork ERU-1 (exposed inside the pool area) shall be aluminum single wall duct.

G. Liner:
   1. Supply Air Ducts Mains: Fibrous glass, Type I, R-6.
   2. Exterior Supply Air Double-Walled Ducts: Fibrous glass, Type I, R-12.
   3. Return air Ducts: First 15’ of ductwork from supply unit, Type 1, R-6
   4. Transfer Ducts: Fibrous glass, Type I, 25-mm (1 inch) thick.

H. Elbow Configuration:
   1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
      a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
      b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
      c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
   2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."
      a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
         1) Radius-to Diameter Ratio: 1.5.
      b. Round Elbows, 12 Inches (305 mm) and Smaller in Diameter: Stamped or pleated.
      c. Round Elbows, 14 Inches (356 mm) and Larger in Diameter: Standing seam.

I. Branch Configuration:
   1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."
      a. Rectangular Main to Rectangular Branch: 45-degree entry.
      b. Rectangular Main to Round Branch: Spin in.
   2. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees." Saddle taps are permitted in existing duct.

END OF SECTION 23 3113

SECTION 23 3116

NONMETAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fabric Duct.

B. Related Requirements:
1. Section 230548 "Vibration and Seismic Controls for HVAC" for vibration-isolated and restrained ductwork hangers and supports.
2. Section 230548.13 "Vibration Controls for HVAC" for vibration-isolated ductwork and hangers.
3. Section 233113 "Metal Ducts" for single- and double-wall, rectangular and round ducts.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of the following products:
1. Fabric Ducts

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Duct layout indicating sizes and pressure classes.
3. Elevation of top of ducts.
4. Dimensions of main duct runs from building grid lines.
5. Fittings.
6. Reinforcement and spacing.
7. Seam and joint construction.
8. Penetrations through fire-rated, smoke-rated, and other partitions.
9. Fire and smoke damper locations.
10. Equipment installation based on equipment being used on Project.
11. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, or BIM model, drawn to scale, showing the items described in this Section and coordinated with all building trades.

B. Seismic Qualification Data: Certificates, for nonmetal ducts, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Hanger and Support Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for steel hangers and supports.
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum hangers and supports.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1, Section 5.4 - "Airstream Surfaces."

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

C. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

D. NFPA Compliance:

1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

2.2 FABRIC DUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Basis of Design:
   a. DuctSox Corporation (1-800-553-5560).
2. Alternate Manufacturers:
   a. Prihoda
   b. FabricAir

B. Hangers and Supports for Fabric Ducts:

1. Fabric ducts shall be supplied with a manufactured internal retention system consisting of a 360 degree hoop system, spaced a maximum of 5' on center.
2. The Fabric duct suspension system shall utilitize a single row track located 1.5" above top-dead- center of the duct.
    a. The Fabric duct shall attach to the suspension track a maximum of every 12".
    b. The track suspension hardward shall include 8' sections of aluminum track, aluminum splice connectors, track endcaps and vertical cable support kits.
        1) Fabric ducts located in the pool shall utilize aluminum hangers with plastic impregnated cables.
        2) Fabric ducts not located in the pool shall utilize galvanized hangers with galvanized steel cables.

2.3 FABRIC DUCT SCHEDULE

A. The following Fabric duct materials are the basis of design. Substitutions conforming to the requirements listed within this specification will be considered for prior approval.

B. DuctSox Verona:
1. Verona fabric ducts are to be utilized in open workout areas and as shown on plan.
2. Construction: Filament/filament twill polyester, fire retardant in accordance with UL 2518.
3. Air Permeability: 2 (+2/-1) CFM/ft2 per ASTM D737, Frazier
4. The air permeability of the fabric must NOT be created by perforating the fabric.
5. Weight: 6.8 oz. /yd2 per ASTM D3776
6. Color: White.
7. Nozzle Type:
    a. Air dispersion accomplished by linear vent and permeable fabric. Linear vents must be sized in 1 CFM per linear foot increments (based on .5” SP), starting a 1 CFM through 90 CFM per linear foot. Linear vent is to consist of an array of open orifices rather than a mesh style vent to reduce maintenance requirements of mesh style vents. Linear vents should also be designed to minimize dusting on fabric surface.
    b. Size of vent openings and location of linear vents to be specified and approved by manufacturer.

C. DuctSox TufTex:
1. TufTex fabric ducts are to be utilized in the gym and as shown on plan.
2. Construction: Woven polyester with non-permeable coating, fire retardant in accordance with UL 2518.
3. Air Permeability: 0 CFM/ft2 per ASTM D737, Frazier
4. Weight: 8.2 oz./yd2 per ASTM D3776
5. Color: White.
6. Nozzle Type:
    a. Air dispersion and extended throws are accomplished by orifices.
    b. Diameter, quantity, and location of orifices to be specified and approved by manufacturer.

D. DuctSox Sedona XM:
1. Sedona XM fabric ducts are to be utilized in the pool area and as shown on plan.
2. Construction: Filament/filament twill polyester treated with a machine washable anti-microbial agent by the fabric manufacturer, fire retardant in accordance with UL 2518.
3. Air Permeability: 2 (+2/-1) CFM/ft2 per ASTM D737, Frazier
    a. The air permeability of the fabric must NOT be created by perforating the fabric.
4. Weight: 6.8 oz. /yd2 per ASTM D3776
5. Color: Silver.
6. Nozzle Type:

a. Air dispersion and extended throws are accomplished by reinforced orifices and permeable fabric. Reinforced orifices are to be installed to keep the integrity of opening and withstand laundry processes.
b. Diameter, quantity, and location of reinforced orifices to be specified and approved by manufacturer.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

3.2 DUCT INSTALLATION

A. Install ducts with fewest possible joints.

B. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

C. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

D. Install ducts with a clearance of 1 inch (25 mm).

E. Protect duct interiors from the moisture, construction debris and dust, and other foreign materials.

3.3 HANGER AND SUPPORT INSTALLATION

A. Install hangers and supports according to manufacturer’s installation instructions.

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
1. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
2. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 100 mm 4 inches thick.
3. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 100 mm 4 inches thick.
4. All fasteners located in the pool area must be stainless steel to prevent corrosion.

C. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.4 CLEANING AND PROTECTION:

A. Clean air handling unit and ductwork prior to the installation of the fabric duct system. Clean external surfaces of foreign substance which may cause corrosive deterioration of facing.

B. Temporary Closure: At ends of ducts which are not connected to equipment or distribution devices at time of ductwork installation, cover with polyethylene film or other covering which will keep the system clean until installation is completed.

C. If the fabric duct system becomes soiled during installation, they should be removed and cleaned following the manufacturers standard terms of laundry.

3.5 DUCT SCHEDULE

A. See drawings for “Fabric Duct Schedule.”

B. The DuctSox material shall be furnished as follows:

END OF SECTION 23 3116

AREA	FABRIC TYPE	COLOR	HANGING SYSTEM
Pool Areas	Sedona XM	Silver	Suspended U-Track with Skelecore IHS hung from structure with impregnated cable track supports and appropriate aluminum and chrome plated cable attachments for natatorium applications. Hanger fasteners shall be 1/4 inch Hilti Kwik-Con II 410 stainless steel with 5/16 inch hex head and internal T-25 Torx recess.
Work Out Areas	Verona	White	Suspended U-Track with Skelecore IHS hung from structure with galvanized cable track supports and appropriate cable attachments.
Gym Areas	TufTex	White	Suspended U-Track with Skelecore IHS hung from structure with galvanized cable track supports and appropriate cable attachments.

SECTION 23 3300

AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Backdraft and pressure relief dampers.
2. Manual volume dampers.
3. Control dampers.
4. Fire dampers.
5. Combination fire and smoke dampers.
6. Turning vanes.
7. Duct-mounted access doors.
8. Flexible connectors.
9. Duct accessory hardware.

B. Related Requirements:
1. Section 284621.11 "Addressable Fire-Alarm Systems" for duct-mounted fire and smoke detectors.
2. Section 284621.13 "Conventional Fire-Alarm Systems" for duct-mounted fire and smoke detectors.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details, and attachments to other work.

1. Detail duct accessories' fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:

a. Special fittings.
b. Manual volume damper installations.
c. Control-damper installations.
d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor-damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
e. Duct security bars.
f. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, or BIM model, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from installers of the items involved.

B. Source quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with NFPA 90A and NFPA 90B.

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2 BACKDRAFT DAMPERS

2.3 Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Arrow United Industries: Series #500.
2. Dowco, Louvers & Dampers, Inc.
3. Wherever indicated on the drawings that the gravity damper is to produce a positive pressure in the building the series type shall be changed to #425.

B. Description: Gravity balanced.

C. Maximum Air Velocity: 2000 fpm.

D. Maximum System Pressure: 1-inch wg.

E. Frame: 0.052-inch- thick, 2-inch or 4-inch extruded aluminum channel frame.

F. Blades: Multiple single-piece blades, center-pivoted, maximum 6-inch width, 0.050-inch- thick aluminum sheet noncombustible, tear-resistant, neoprene-coated fiberglass with sealed edges.

G. Blade Action: Parallel.

H. Blade Seals: Polyurethane, mechanically locked.

I. Blade Axles:
   1. Material: Nonferrous metal.
   2. Diameter: 0.20 inch.

J. Tie Bars and Brackets: Galvanized steel.

K. Return Spring: Adjustable tension.

L. Bearings: Steel ball or synthetic pivot bushings.

M. Accessories:
   1. Adjustment device to permit setting for varying differential static pressure.
   2. Counterweights and spring-assist kits for vertical airflow installations.
   3. Electric actuators.
   4. Chain pulls.
   5. Screen Material: Galvanized steel or Aluminum to match system installed in.
   6. Screen Type: Bird.
   7. 90-degree stops.

2.4 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Air Balance Inc.; a division of Mestek, Inc.
      b. McGill AirFlow LLC.
      c. Ruskin Company.
      d. Young Regulator.
   2. Standard leakage rating, with linkage outside airstream.
   3. Suitable for horizontal or vertical applications.
   4. Frames:
      a. Hat-shaped, galvanized-steel channels, 0.064-inch minimum thickness.
      b. Mitered and welded corners.
      c. Flanges for attaching to walls and flangeless frames for installing in ducts.
   5. Blades:
      a. Multiple or single blade.
      b. Parallel- or opposed-blade design.
      c. Stiffen damper blades for stability.
      d. Galvanized-steel, 0.064 inch thick.
      e. Blade Axles: Nonferrous metal.
   6. Bearings:
      a. Molded synthetic.
      b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
   7. Tie Bars and Brackets: Galvanized steel.
   8. Quadrants:
      a. Provide locking, indicating quadrant regulators.

b. On insulated ducts mount quadrant regulators on stand-off mounting brackets.

B. Standard, Aluminum, Manual Volume Dampers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
a. Air Balance Inc.; a division of Mestek, Inc.
b. McGill AirFlow LLC.
c. Ruskin Company.
d. Young Regulator.
2. Standard leakage rating, with linkage outside airstream.
3. Suitable for horizontal or vertical applications.
4. Frames: Hat-shaped, 0.10-inch- thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
5. Blades:
a. Multiple or single blade.
b. Parallel- or opposed-blade design.
c. Stiffen damper blades for stability.
d. Roll-Formed Aluminum Blades: 0.10-inch- thick aluminum sheet.
e. Extruded-Aluminum Blades: 0.050-inch- thick extruded aluminum.
6. Blade Axles: Nonferrous metal.
7. Bearings:
a. Molded synthetic.
b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
8. Tie Bars and Brackets: Aluminum.
9. Quadrants:
a. Provide locking, indicating quadrant regulators.
b. On insulated ducts mount quadrant regulators on stand-off mounting brackets.

2.5 IRIS BALANCING DAMPER

A. Standard Galvanized Steel Iris Dampers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Ruskin Company
2. Leakage rating: 6 cfm max.
3. Frame: Galvanized Steel
4. Blades: Galvanized Steel

B. Stainless Steel Iris Dampers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Ruskin Company
2. Leakage rating: 6 cfm max.
3. Frame: Stainless Steel
4. Blades: Stainless Steel

2.6 MOTORIZED CONTROL DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Arrow United Industries: Model 1770.
2. Dowco.

3. Louvers & Dampers, Inc.
4. Westco.
5. Ruskin Company

B. Frames:
1. Hat shaped.
2. Galvanized-steel channels, 0.064 inch thick.
3. Mitered and welded corners.

C. Blades:
1. Multiple blade with maximum blade width of 8 inches.
2. Blade design.
a. Positive pressure: Parallel.
b. Negative pressure: Opposed.
3. Galvanized steel.
4. 4 inch thick.
5. Blade Edging: Closed-cell neoprene edging.
6. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.

D. Blade Axles: 1/2-inch- diameter; nonferrous metal; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.
1. Operating Temperature Range: From minus 40 to plus 200 deg F.

E. Bearings:
1. Oil-impregnated bronze.
2. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
3. Thrust bearings at each end of every blade.

F. Damper Motors: Two-Position Action – Belimo Model #FSNF120-S-FC US, 120 V actuator with dual auxiliary switches, NO EXCEPTIONS.

G. Operator: Supplied by the temperature control sub-contractor, unless specifically noted in the exhaust fan specification and schedule on the drawings.

H. Shop drawings for dampers shall be approved by Engineer and Temperature Control Sub-Contractor.

2.7 FIRE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Air Balance Inc.; a division of Mestek, Inc.
2. National Controlled Air.
3. Ruskin Company.
4. Greenheck.

B. Type: Dynamic; rated and labeled according to UL 555 by an NRTL.

C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 4000-fpm velocity.

D. Fire Rating: 1-1/2 hours.

E. Frame: Curtain type with blades outside airstream except when located behind grille where blades may be inside airstream; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.

F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
   1. Minimum Thickness: 0.052 or 0.138 inch thick, as indicated, and of length to suit application.
   2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.

G. Mounting Orientation: Vertical or horizontal as indicated.

H. Blades: Roll-formed, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.

I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.

J. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

K. Fire dampers located in pool room and pool equipment room exhaust ductwork shall be manufactured with stainless steel to prevent corrosion.

2.8 SMOKE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Air Balance Inc.; a division of Mestek, Inc.
   2. National Controlled Air.
   3. Ruskin Company.
   4. Greenheck.

B. General Requirements: Label according to UL 555S by an NRTL.

C. Smoke Detector: Integral, factory wired for single-point connection.

D. Frame: Curtain type with blades outside airstream except when located behind grille where blades may be inside airstream; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.

E. Blades: Roll-formed, horizontal, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.

F. Leakage: Class II.

G. Rated pressure and velocity to exceed design airflow conditions.

H. Mounting Sleeve: Factory-installed, 0.052-inch- thick, galvanized sheet steel; length to suit wall or floor application.

I. Damper Motors: Two-Position Action – Belimo Model #FSNF120-S-FC US, 120 V actuator with dual auxiliary switches, NO EXCEPTIONS..

J. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC."
   1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
   2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.
   3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
   4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
   5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
   6. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
   7. Electrical Connection: 115 V, single phase, 60 Hz.

K. Operator: Electric normally closed upon loss of power.

L. Accessories:
   1. Dual auxilary switch, wired through the fire alarm system and smoke detectors by Division 26 contactor.
   2. Test and reset switches, damper mounted.

2.9 FIRE/SMOKE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Air Balance Inc.; a division of Mestek, Inc.
   2. National Controlled Air.
   3. Ruskin Company.
   4. Greenheck Fan Corporation.

B. General Requirements: Label according to UL 555S by an NRTL.

C. Smoke Detector: Integral, factory wired for single-point connection.

D. Frame: Curtain type with blades outside airstream except when located behind grille where blades may be inside airstream; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.

E. Blades: Roll-formed, horizontal, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.

F. Leakage: Class II.

G. Rated pressure and velocity to exceed design airflow conditions.

H. Mounting Sleeve: Factory-installed, 0.052-inch- thick, galvanized sheet steel; length to suit wall or floor application.

I. Damper Motors: Two-Position Action – Belimo Model #FSNF120-S-FC US, 120 V actuator with dual auxiliary switches, NO EXCEPTIONS.

J. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC."
   1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
   2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.
   3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
   4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
   5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
   6. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
   7. Electrical Connection: 115 V, single phase, 60 Hz.

K. Operator: Electric normally closed upon loss of power.

L. Accessories:
   1. Dual auxiliary switch, wired through the fire alarm system and smoke detectors by Division 26 contactor.
   2. Test and reset switches, damper mounted.

2.10 TURNING VANES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Tuttle and Bailey: Ductturns.
   2. Or equal and approved.

B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
   1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."

D. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.11 DUCT-MOUNTED ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Cesco Products; a division of Mestek, Inc.

2. McGill AirFlow LLC.

B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-10, "Duct Access Doors and Panels," and 2- 11, "Access Panels - Round Duct."
   1. Door:
   2. Double wall, rectangular.
   3. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
   4. Vision panel.
   5. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
   6. Fabricate doors airtight and suitable for duct pressure class.

C. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.

D. Number of Hinges and Locks:
   1. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
   2. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
   3. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches.
   4. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.

E. Pressure Relief Access Door:
   1. Door and Frame Material: Galvanized sheet steel.
   2. Door: Double wall with insulation fill with metal thickness applicable for duct pressure class.
   3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.
   4. Factory set at 10-inch wg.
   5. Doors close when pressures are within set-point range.
   6. Hinge: Continuous piano.
   7. Latches: Cam.
   8. Seal: Neoprene or foam rubber.
   9. Insulation Fill: 1-inch- thick, fibrous-glass or polystyrene-foam board.

2.12 DUCT ACCESS PANEL ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Flame Gard, Inc.
   2. 3M.

B. Labeled according to UL 1978 by an NRTL.

C. Panel and Frame: Minimum thickness 0.0528-inch carbon steel.

D. Fasteners: Carbon steel. Panel fasteners shall not penetrate duct wall.

E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.

F. Minimum Pressure Rating: 10-inch wg, positive or negative.

2.13 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Johns-Manville.

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Flexible Connector Fabric: Canvas double coated with neoprene.
   1. Thickness: 0.0625-inch.

2.14 FLEXIBLE DUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Flexmaster U.S.A., Inc.
   2. McGill AirFlow LLC.
   3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Insulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.
   1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
   2. Maximum Air Velocity: 4000 fpm.
   3. Temperature Range: Minus 10 to plus 160 deg F.
   4. Insulation R-value: Comply with ASHRAE/IESNA 90.1-2004.

C. Flexible Duct Connectors:
   1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.

2.15 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct- insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories in accordance with applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116 for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless steel accessories in stainless steel ducts, and aluminum accessories in aluminum ducts.

C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. Where multiple damper sections are necessary to achieve required dimensions, provide reinforcement to fully support damper assembly when fully closed at full system design static pressure.

E. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

1. Install steel volume dampers in steel ducts.
2. Install aluminum volume dampers in aluminum ducts.

F. Set dampers to fully open position before testing, adjusting, and balancing.

G. Install test holes at fan inlets and outlets and elsewhere as indicated and as needed for testing and balancing.

H. Install fire and smoke dampers in accordance with UL listing.

I. Connect ducts to duct silencers rigidly.

J. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. On both sides of duct coils.
2. Upstream and downstream from duct filters.
3. At outdoor-air intakes and mixed-air plenums.
4. At drain pans and seals.
5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
7. At each change in direction and at maximum 50-ft. spacing.
8. Upstream from turning vanes.
9. Upstream or downstream from duct silencers.
10. For grease ducts, install at locations and spacing as required by NFPA 96.
11. Control devices requiring inspection.
12. Elsewhere as indicated.

K. Install access doors with swing against duct static pressure.

L. Access Door Sizes:

1. One-Hand or Inspection Access: 8 by 5 inches.
2. Two-Hand Access: 12 by 6 inches.

3. Head and Hand Access: 18 by 10 inches.
4. Head and Shoulders Access: 21 by 14 inches.
5. Body Access: 25 by 14 inches.
6. Body plus Ladder Access: 25 by 17 inches.

M. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

N. Install flexible connectors to connect ducts to equipment.

O. For fans developing static pressures of 5 inches wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

P. Install duct test holes where required for testing and balancing purposes.

Q. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors, and verify that size and location of access doors are adequate to perform required operation.
3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation, and verify that vanes do not move or rattle.
5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 23 3300

SECTION 23 3423

HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Ceiling-mounted ventilators.
   2. Centrifugal ventilators - roof downblast.
   3. Centrifugal ventilators - roof upblast or sidewall.
   4. In-line centrifugal fans.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

   1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes for fans.
   2. Rated capacities, operating characteristics, and furnished specialties and accessories.
   3. Certified fan performance curves with system operating conditions indicated.
   4. Certified fan sound-power ratings.
   5. Motor ratings and electrical characteristics, plus motor and electrical accessories.
   6. Material thickness and finishes, including color charts.
   7. Dampers, including housings, linkages, and operators.
   8. Prefabricated roof curbs.
   9. Fan speed controllers.

B. Shop Drawings:

   1. Include plans, elevations, sections, and attachment details.
   2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Include diagrams for power, signal, and control wiring.
   4. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints.

C. Delegated Design Submittal: For unit hangars and supports indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

   1. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, or BIM model, drawn to scale, showing the items described in this Section and coordinated with all building trades.

B. Seismic Qualification Data: For fans, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity, and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Product Certificates: Submit certificates that specified equipment will withstand required wind forces, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculations.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of wind force and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For HVAC power ventilators to include in normal and emergency operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of unit components.

C. ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

D. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

E. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design vibration isolation**[, supports,]** [**and seismic restraints**], including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

2.2 CENTRIFUGAL ROOF VENTILATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Greenheck.
   2. Cook
   3. Twin City Fan
   4. Plastec
   5. Or approved equal.

B. Description: Direct- or belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.

C. Housing - Greenheck: Removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.
   1. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.

D. Housing - Plastec: Constructed of strong high-density UV treated polypropylene for corrosion resistance.
   1. Hinged Subbase: Motor housing to sit on roof curb fan base and screwed to curb with stainless steel screws.

E. Fan Wheels - Greenheck: Aluminum hub and wheel with backward-inclined blades.

F. Fan Wheels - Plastec: Forward-curved type and constructed of uniformly molded polypropylene blades. Wheel shall be both electronically and dynamically balanced. Fan wheel shall be supplied with a motor shaft bushing and hubcap made of polypropylene to protect shaft end.

G. Belt-Driven Drive Assembly: Resiliently mounted to housing, with the following features:
   1. Resiliently mounted to housing.
   2. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
   3. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
   4. Pulleys: Cast-iron, adjustable-pitch motor pulley.
   5. Fan and motor isolated from exhaust airstream.

H. Driven Drive Assembly: Resiliently mounted to housing, with the following features:
   1. Motor: Shall be totally enclosed fan cooled (TEFC), UL and CSA compliant.
   2. Shaft Bearings: Heavy duty, lubricated for life ball bearing type for continuous duty.
   3. Motor shall be outside the air steam and pre-wired to a disconnect switch for safety.

I. Accessories:
   1. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
   2. Bird Screens: Removable, 13-mm (1/2-inch) mesh, aluminum or brass wire.
   3. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops, Unless otherwise noted on plan.

J. Roof Curbs: Galvanized steel; mitered and welded corners; 40-mm- (1-1/2-inch-) thick, rigid, fiberglass insulation adhered to inside walls; and 40-mm (1-1/2-inch) wood nailer. Size as required to suit roof opening and fan base.
   1. Configuration: Built-in cant and mounting flange.
   2. Overall Height: 600 mm (24 inches).
   3. Sound Curb: Curb with sound-absorbing insulation matrix.
   4. Pitch Mounting: Manufacture curb for roof slope.

5. Metal Liner: Galvanized steel.
6. Mounting Pedestal: Galvanized steel with removable access panel.

2.3 CEILING-MOUNTING VENTILATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Greenheck.

B. Description: Centrifugal fans designed for installing in ceiling or wall or for concealed in-line applications.

C. Housing: Steel, lined with acoustical insulation.

D. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.

E. Grille: Standard, louvered grille with flange on intake and thumbscrew attachment to fan housing.

F. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.

G. Accessories:
   1. Cooling thermostat: 120 Volt.

2.4 IN-LINE CENTRIFUGAL FANS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Greenheck.
   2. Plastec.

B. Description - Greenheck: In-line, belt-driven centrifugal fans consisting of housing, wheel, outlet guide vanes, fan shaft, bearings, motor and disconnect switch, drive assembly, mounting brackets, and accessories.

C. Description - Plastec: In-line, direct-driven corrosive air application centrifugal fans consisting of housing, wheel, outlet guide vanes, fan shaft, bearings, motor and disconnect switch, drive assembly, mounting brackets, and accessories.

D. Housing - Greenheck: Split, spun aluminum with aluminum straightening vanes, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.

E. Housing - Plastec: Constructed of strong high-density UV treated polypropylene for corrosion resistance. Housing shall be made of on single piece to completely avoid leaks. Split molded housing is not allowed.

F. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.

G. Driven Drive Assembly: Resiliently mounted to housing, with the following features:

1. Motor: Shall be totally enclosed fan cooled (TEFC), UL and CSA compliant.
2. Shaft Bearings: Heavy duty, lubricated for life ball bearing type for continuous duty.
3. Motor shall be outside the air steam and pre-wired to a disconnect switch for safety.

H. Fan Wheels - Greenheck: Aluminum, airfoil blades welded to aluminum hub.

I. Fan Wheels - Plastec: Forward-curved type and constructed of uniformly molded polypropylene blades. Wheel shall be both electronically and dynamically balanced. Fan wheel shall be supplied with a motor shaft bushing and hubcap made of polypropylene to protect shaft end.

J. Accessories:
1. Volume-Control Damper: Manually operated with quadrant lock, located in fan outlet.
2. Companion Flanges: For inlet and outlet duct connections.
3. Fan Guards: 13- by 25-mm (1/2- by 1-inch) mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.
4. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.

2.5 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements For HVAC."
1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.

B. Enclosure Type: Totally enclosed, fan cooled.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install power ventilators level and plumb.

B. Equipment Mounting:

1. Secure roof-mounted fans to roof curbs with zinc-plated hardware. See Section 077200 "Roof Accessories" for installation of roof curbs.
2. Ceiling Units: Suspend units from structure; use steel wire or metal straps.
3. Comply with requirements for vibration isolation and seismic-control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
4. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

C. Install units with clearances for service and maintenance.

D. Label units according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

3.2 DUCTWORK CONNECTIONS

A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 233300 "Air Duct Accessories."

3.3 ELECTRICAL CONNECTIONS

A. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.

1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."
2. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

3.4 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring according to Section 260523 "Control-Voltage Electrical Power Cables."

3.5 STARTUP SERVICE:

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks in accordance with manufacturer's written instructions.
2. Verify that shipping, blocking, and bracing are removed.
3. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
4. Verify that cleaning and adjusting are complete.
5. For direct-drive fans, verify proper motor rotation direction and verify fan wheel free rotation and smooth bearing operation.
6. For belt-drive fans, disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
7. Adjust belt tension.
8. Adjust damper linkages for proper damper operation.
9. Verify lubrication for bearings and other moving parts.
10. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
11. Disable automatic temperature-control operators, energize motor and confirm proper motor rotation and unit operation, adjust fan to indicated rpm, and measure and record motor voltage and amperage.

12. Shut unit down and reconnect automatic temperature-control operators.
13. Remove and replace malfunctioning units and retest as specified above.

3.6 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Lubricate bearings.

D. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.7 CLEANING

A. After completing system installation and testing, adjusting, and balancing and after completing startup service, clean fans internally to remove foreign material and construction dirt and dust.

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections with the assistance of a factory-authorized service representative.

1. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Test and adjust controls and safeties.
3. Fans and components will be considered defective if they do not pass tests and inspections.
4. Prepare test and inspection reports.

END OF SECTION 23 3423

SECTION 23 3600

AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Modulating, single-duct air terminal units.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of air terminal unit.

   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for air terminal units.
   2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For air terminal units.

   1. Include plans, elevations, sections, and mounting details.
   2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Include diagrams for power, signal, and control wiring.
   4. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans and other details, or BIM model, drawn to scale, indicating the items described in this Section, and coordinated with all building trades.

B. Seismic Qualification Data: For air terminal units, accessories, and components, from manufacturer.

   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air terminal units to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. Instructions for resetting minimum and maximum air volumes.
b. Instructions for adjusting software set points.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a Qualified Electrical Testing Laboratory, and marked for intended location and application.

B. ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Start-up."

C. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, "Section 6 - Heating, Ventilating, and Air Conditioning."

D. Seismic Performance: Air terminal units shall withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7. See Section 230548 "Vibration and Seismic Controls for HVAC."

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
2. Component Importance Factor: 1.0.

2.2 MODULATING, SINGLE-DUCT AIR TERMINAL UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Price Industries Model #SDV
2. Titus Model #DESV
3. Nailor 3000 Series

B. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.

C. Casing: 0.85-mm (0.034-inch) steel, fiber free foam.
1. Casing Lining: Adhesive attached, 3/4-inch thick, coated, fiber free polymer foam duct liner complying with ASTM C 665, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.
a. Liner – Fiber free polymer foam with sealed edges, model no. FF.
2. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment.
3. Air Outlet: S-slip and drive connections.

4. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket.

D. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.
1. Maximum Damper Leakage: ARI 880 rated, 2 percent of nominal airflow at 750-Pa (3-inch wg) inlet static pressure.
2. Damper Position: Normally open.

E. Electric-Resistance Heating Coils: Nickel-chromium heating wire, free of expansion noise and hum, mounted in ceramic inserts in a galvanized-steel housing; with primary automatic, and secondary manual, reset thermal cutouts. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware.
1. Access door interlocked disconnect switch.
2. Downstream air temperature sensor with local connection to override discharge-air temperature to not exceed a maximum temperature set point (adjustable.)
3. Nickel chrome 80/20 heating elements.
4. Airflow switch for proof of airflow.
5. Fan interlock contacts.
6. Fuses in terminal box for overcurrent protection (for coils more than 48 A).
7. Proportional SCR controller to modulate heater load according to the temperature control signal.

F. Direct Digital Controls: Bidirectional damper operators and microprocessor-based controller and room sensor. Control devices shall be compatible with temperature controls specified in Division 23 Section "HVAC Instrumentation and Controls" and shall have the following features:
1. Damper Actuator: 24 V, powered closed, spring return open.
2. Terminal Unit Controller: Pressure-independent, variable-air-volume controller with electronic airflow transducer with multipoint velocity sensor at air inlet, factory calibrated to minimum and maximum air volumes, and having the following features:
   a. Remote reset of airflow or temperature set points.
   b. Adjusting and monitoring with portable terminal.
   c. Linked Interface and software for PIC Controller
3. Room Sensor: Wall mounted temperature sensor BACnet compatible
   a. Mother's, Infants, and other rooms as shown on plan - adjustable sensor with LCD display and temperature set-point adjustment.
   b. All other spaces - non-adjustable sensor without display.

2.3 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Steel Cables: Galvanized steel complying with ASTM A 603.

C. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

D. Air Terminal Unit Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

E. Trapeze and Riser Supports: Steel shapes and plates for units with steel casings; aluminum for units with aluminum casings.

2.4 SOURCE QUALITY CONTROL

A. Factory Tests: Test assembled air terminal units according to ARI 880.
   1. Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory- set airflows, and ARI certification seal.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Comply with Section 230529 "Hangers and Supports for HVAC Piping and Equipment" and Section 233113 "Metal Ducts" for hangers and supports.

B. Install air terminal units according to NFPA 90A.

C. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.

D. Install wall-mounted thermostats.

3.2 DUCTWORK CONNECTIONS

A. Comply with requirements in Section 233113 "Metal Ducts" for connecting ducts to air terminal units.

B. Make connections to air terminal units with flexible connectors complying with requirements in Section 233300 "Air Duct Accessories."

3.3 ELECTRICAL CONNECTIONS

A. Install field power to each air terminal unit electrical power connection. Coordinate with air terminal unit manufacturer and installers.

B. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

D. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.

E. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

   1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."
   2. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

3.4 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring in accordance with Section 260523 "Control-Voltage Electrical Power Cables."

3.5 IDENTIFICATION

A. Label each air terminal unit with drawing designation, nominal airflow, maximum and minimum factory-set airflows, and coil type. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for equipment labels and warning signs and labels.

3.6 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks in accordance with manufacturer's written instructions.
2. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
3. Verify that controls and control enclosure are accessible.
4. Verify that control connections are complete.
5. Verify that nameplate and identification tag are visible.
6. Verify that controls respond to inputs as specified.

3.7 ADJUSTING

A. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for air terminal unit testing, adjusting, and balancing.

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Contractor will engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections:

1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
2. Leak Test: After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Air terminal unit will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.9 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain air terminal units.

END OF SECTION 23 3600

SECTION 23 3713

AIR DIFFUSERS, REGISTERS, GRILLES, AND LOUVERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Diffusers.
2. Registers.
3. Grilles.
4. Louvers.

B. Related Requirements:

1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers.

1.2 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.

a. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
b. Diffuser Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

B. Samples for Initial Selection: For diffusers with factory-applied color finishes. Actual size of smallest diffuser indicated.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Ceiling suspension assembly members.
2. Method of attaching hangers to building structure.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items, including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
5. Duct access panels.

B. Source quality-control reports.

PART 2 - PRODUCTS

2.1 The frames for all diffusers, registers and grilles shall match the type of ceiling where they are to be installed. Refer to reflected ceiling plan, drawings and other specification divisions for ceiling types. See drawings and schedules for additional information.

2.2 DIFFUSERS, REGISTERS AND GRILLES

A. Diffuser, Registers and Grilles:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   2. Price Industries.
   3. Krueger.
   4. Titus.
   5. Adjustable square ceiling diffusers shall be Price Industries of sizes indicated on the drawings and types as specified in the schedule or notes on the drawings.
   6. Exhaust registers in the locker rooms shall be aluminum to prevent corrosion.
   7. Exhaust registers and all components in the pool area shall be aluminum to prevent corrosion.

2.3 LOUVERS

A. Louvers:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Greenheck.
      b. Pottorff.
      c. Louvers & Dampers, Inc.

B. All louvers shall be provided by this Contractor.

C. Construction:
   1. Channel Frame: 0.81-inch (20.5-mm) extruded aluminum.
   2. Blades: 4-inch (100-mm) deep.
   3. Screen: 1/2-inch (12.7-mm) mesh.
   4. Sill extension: 4-inch (100-mm) where required.
   5. Finish: To be verified by Architect prior to ordering.

2.4 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers in accordance with ASHRAE 70.

PART 3 - EXECUTION

3.1 INSTALLATION OF DIFFUSERS, REGISTERS AND GRILLES

A. Install diffusers, registers, and grilles level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.2 LOUVER INSTALLATION

A. Locate and place louvers and vents level, plumb, and at indicated alignment with adjacent work.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weather tight connection.

C. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

D. Repair damaged finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory and refinish entire unit or provide new units.

E. Protect galvanized and nonferrous-metal surfaces that will be in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint.

3.3 ADJUSTING

A. After installation, adjust diffusers to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 23 3713

SECTION 23 5116

BREECHINGS, CHIMNEYS, AND STACKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Listed double wall vents.
2. Positive pressure vents.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for product.

B. Shop Drawings: For breechings.

1. Include plans, elevations, sections, and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Detail fabrication and assembly of hangers and seismic restraints.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Seismic Qualification Certificates: For factory-fabricated breeching, accessories, and components from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity, and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Sample Warranty: For special warranty.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D9.1/D9.1M, "Sheet Metal Welding Code," for shop and field welding of joints and seams in breechings.

B. Certified Sizing Calculations: Manufacturer shall certify venting system sizing calculations.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of venting system that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, structural failures caused by expansion and contraction.
2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LISTED SPECIAL GAS VENT

A. Available Manufacturers:
1. Heat-Fab Inc.
2. Jeremias

B. Installing contractor must develop and detailed and fully dimensioned sketch of each boiler venting route from outlet of boiler to final termination. Sketch must be emailed to Chris Pierson at RM Cotton (cpierson@rmcotton.com) so a completed bill of material can be developed and an installation drawing can be generated. Once the installation drawing is approved by the installing contractor, venting will be ordered. General venting lead-time is 8-10 weeks after an order is placed

C. Description: Double-wall metal vents tested according to UL 103 and rated for 1000 deg F (537 deg C) continuously, 1400 deg F intermittent, with positive or negative flue pressure complying with NFPA 211 and suitable for condensing-gas appliances.

D. Construction: Inner shell and outer jacket separated by at least a 1/2-inch (13-mm) airspace.

E. Inner Shell: ASTM A 959, Type 29-4C stainless steel.

F. Outer Jacket: 430 stainless steel.

G. Accessories: Tees, elbows, increasers, draft-hood connectors, terminations, adjustable roof flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners; fabricated from similar materials and designs as vent-pipe straight sections; all listed for same assembly.
1. Termination: Round chimney top designed to exclude 98 percent of rainfall.

2.2 GUYING AND BRACING MATERIALS

A. Cable: Three galvanized, stranded wires of the following thickness:
   1. Minimum Size: 1/4 inch (6 mm) in diameter.
   2. For ID Sizes 4 to 15 Inches (100 to 381 mm): 5/16 inch (8 mm).
   3. For ID Sizes 18 to 24 Inches (457 to 610 mm): 3/8 inch (9.5 mm).

B. Pipe: Three galvanized steel, NPS 1-1/4 (DN 32).

C. Angle Iron: Three galvanized steel, 2 by 2 by 0.25 inch (50 by 50 by 6 mm).

2.3 POSITIVE PRESSURE VENTS

A. The vent shall be of the single wall, factory-built type, designed for use in conjunction with Category II, or IV condensing gas fired appliances, condensing oil fired appliances or as specified by the heating equipment manufacturer.

B. All products furnished under this Section shall conform to the requirements of The National Fuel Gas Code, ANSI Z223.1/NFPA-54 where applicable and shall comply with and be listed to UL-1738, the US Standard for Venting Systems for Gas-Burning Appliances, Categories II, III, and IV and ULC- S636-95, the Canadian Standard for Type BH gas vent systems. These requirements cover venting systems intended for venting Category II or IV gas-burning appliances as defined by the Standard for Gas-Fired Central Furnaces (except Direct-Vent Central Furnaces), ANSI Z21.47 and the National Fuel Gas Code, NFPA 54. Venting systems covered by these requirements are intended to be used with Category II, III, and IV appliances that have been installed in accordance with NFPA 54, and with codes such as the BOCA National Mechanical Code, the Standard Mechanical Code, the Uniform Mechanical Code, and local codes. Components coming in direct contact with products of combustion shall carry the appropriate UL/cUL labels

C. Manufacturer: InnoFlue by Centrotherm

D. Maximum continuous flue gas temperature shall not exceed 230 degrees F (110 degrees C).

E. Vent shall be listed for a maximum positive pressure rating of 20” w.c.

F. The vent system shall be continuous from the appliance’s flue outlet to the vent termination outside the building. All systems components shall be UL/cUL listed and supplied by the same manufacturer.

G. The vent shall be constructed from Flame Resistant Polypropylene, with a min. wall thickness of:

Diameter		Wall thickness extruded pipes			
Diameter (mm)	diameter (inch)	min (mm)	max (mm)	min (inch)	max (inch)
DN 60	2"	1.7	2.2	0.0669	0.0866
DN 80	3"	1.8	2.4	0.0709	0.0945
DN 110	4"	2.4	3.2	0.0945	0.1260
DN 125	5"	2.7	3.7	0.1063	0.1457
DN 160	6"	2.9	4.5	0.1142	0.1772
DN 200	8"	3.5	4.5	0.1378	0.1772

DN 250	10"	3.3	4.7	0.1299	0.1850
DN 315	12"	4.2	5.8	0.1654	0.2283

H. All systems components such as vent supports, roof or wall penetrations, terminations, appliance connectors and drain fittings required to install the vent system shall be UL/cUL listed and provided by the vent manufacturer.

I. All systems components shall include a factory- installed gasket in their female-end to render the vent air and watertight when the male/female ends are pushed together as per manufacturer's instructions. Vent systems requiring field installed sealants or compounds shall not be acceptable.

J. Vent layout shall be designed and installed in compliance with manufacturer's installation instructions and all applicable local codes.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF LISTED VENTS AND CHIMNEYS

A. Locate to comply with minimum clearances from combustibles and minimum termination heights according to product listing or NFPA 211, whichever is most stringent. The height of flue shall be a minimum of 6' above the roof level on which it is located.

B. Seal between sections of positive-pressure vents according to manufacturer's written installation instructions, using sealants recommended by manufacturer.

C. Support vents at intervals recommended by manufacturer to support weight of vents and all accessories, without exceeding appliance loading.

D. Slope breechings down in direction of appliance, with condensate drain connection at lowest point piped to nearest drain.

E. Connect base section to foundation using anchor lugs of size and number recommended by manufacturer.

F. Join sections with acid-resistant joint cement to provide continuous joint and smooth interior finish.

G. Erect stacks plumb to finished tolerance of no more than 1 inch (25 mm) out of plumb from top to bottom.

H. The vent system must conform with all manufacturer's recommendations and shall utilize UL listed stainless steel AL-29-4C Positive Pressure. The vent must be sized in accordance with the boiler manufacturer's recommendations.

3.3 CLEANING

A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.

B. Clean breechings internally, during and after installation, to remove dust and debris. Clean external surfaces to remove welding slag and mill film. Grind welds smooth and apply touchup finish to match factory or shop finish.

C. Provide temporary closures at ends of breechings, chimneys, and stacks that are not completed or connected to equipment.

END OF SECTION 23 5116

SECTION 23 5216

CONDENSING BOILERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Condensing boilers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for boilers.
2. Include rated capacities, operating characteristics, and furnished specialties and accessories.

B. Shop Drawings: For boilers, boiler trim, and accessories.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans and sections, drawn to scale and coordinated with each other, using input from installers of the items involved.

B. Seismic Qualification Data: Certificates, for boiler, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Source quality-control reports.

D. Field quality-control reports.

E. Sample Warranty: For special warranty.

F. Product Certificates:

1. ASME Stamp Certification and Report: Submit "A," "S," or "PP" stamp certificate of authorization, as required by authorities having jurisdiction, and document hydrostatic testing of piping external to boiler.
2. CSA B51 pressure vessel Canadian Registration Number (CRN).

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For boilers to include in emergency, operation, and maintenance manuals.

1.5 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of boilers that fail in materials or workmanship within specified warranty period. Where "prorated" is indicated, the boiler manufacturer will cover the indicated percentage of cost of replacement parts. With "prorated" type, covered cost decreases as age of equipment increases.

1. Warranty Period for Condensing Boilers:
   a. The boiler manufacturer shall warrant each boiler, including boiler, trim, boiler control system, and all related components and accessories against defects in workmanship and material for a period of 18 months from date of shipment or 12 months from date of installation, whichever comes first. Heat exchanger shall be warranted for a period of ten (10) years non-prorated from date of shipment.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASME Compliance: Fabricate and label boilers to comply with ASME Boiler and Pressure Vessel Code.

C. ASHRAE/IES 90.1 Compliance: Boilers shall have minimum efficiency in accordance with Table 6.8.1-6 and other requirements in Ch. 6 of ASHRAE/IES 90.1.

D. ASHRAE 90.2 Compliance: Boilers shall have minimum efficiency in accordance with Ch. 6 of ASHRAE 90.2.

E. Mounting Base: For securing boiler to concrete base.

1. Seismic Fabrication Requirements: Fabricate mounting base and attachment to boiler pressure vessel, accessories, and components with reinforcement strong enough to withstand seismic forces defined in Section 230548 "Vibration and Seismic Controls for HVAC" when mounting base is anchored to building structure.

2.2 CONDENSING BOILERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. RIELLO: Model# AR

B. Description:
   1. Each boiler shall be completed with all components and accessories necessary for a complete and operable boiler as hereinafter specified. Each boiler shall be assembled with required wiring and piping as a self-contained unit.
   2. The boiler shall be gas fired floor standing condensing boiler with multiple stainless steel(AISI 316L) watertube heat exchangers for redundancy. Each 500 MBH module is fully independent and “stand alone” thus allowing boiler operation even if an adjacent module is turned off.
   3. The boiler shall be designed for a minimum of 20:1 turn down on AR2000 with constant CO2 over the turn down range.
   4. The boiler will use a direct ignition system. The design shall provide quite burner ignition and operation. The burner shall be pre-mix radial type and fire in 360 degrees vertical pattern.

C. Performance:
   1. The boiler shall be ETL certified as a condensing boiler. The boiler shall operate with natural gas or propane and have an ETL certified input rating as noted on the drawings, and shall be listed with AHRI and shall have a minimum thermal efficiency rating of 96.1% at rated input..
   2. The boiler shall be designed for a minimum of 20:1 turn down on AR2000 with constant CO2 over the turn down range.

D. Heat exchanger construction:
   1. The water tube (AISI 316L) stainless steel heat exchangers shall be inspected and tested to ASME Section IV requirements and shall bear the ASME section IV seal of approval..
   2. The heat exchangers shall have welded construction (no gaskets) consisting of two pipes working in parallel. Each pipe shall have three welded joints. The heat exchanger shall be a fully condensing cylindrical counter-flow water tube design with AISI stainless steel tubes and headers.
   3. Each 500 MBH module shall be fully independent and “stand alone” with maximum working pressure of 80 psig (550 kPa).
   4. The individual modules shall be removable from the boiler while the remainder of the modules, on other rows, within the boiler remain firing. The removal and replacement of such heat exchanger shall not require welding or hoisting equipment.
   5. The boiler shall be capable of operating with a minimum outlet water temperature of 68 ºF.
   6. Each heat exchanger shall be accessible for visual inspection and cleaning of all internal fire side surfaces.
   7. The boiler shall be equipped with an ASME certified pressure relief valve on each row; for models AR each heat exchanger shall be furnished with one pressure relief valve.
   8. Each heat exchanger shall be equipped with a dedicated water pump, flow meter, condensate trap and drain valve.
   9. The heating surface of each module shall be 43 SQ.FT/ 500,000BTU.

E. Burner:
   1. The burner shall be a premix burner with a stainless steel knitted metal fiber construction.
   2. The burner shall not produce more than 0.04% of Carbon monoxide (CO) at all firing rates.
   3. The burner shall be certified for Oxides of Nitrogen (NOx) of 9 ppm corrected to 3% oxygen.

4. Air/Gas ratio control gas valve shall operate on the principle of negative pressure and modulate to maintain combustion characteristics across the full operating range, which shall provide safe operation even in the case of blocked air intake.

F. Controls:
1. The boiler shall have a touchscreen display located outside the front panel and a service screen located inside the front panel.
2. The outer display shall have a 7” color touchscreen and shall provide full diagnostics including real time data logging.
3. The control shall display the amount of water flow going through each module.
4. The control shall be capable of lead/lag sequencing up to eight 8 boilers in “Cascade”.
5. The control must display any error codes whether automatically reset or manually reset.
6. The boiler shall be provided as a standard with ModBus RS485 communication capabilities.
7. Optional protocol converter for ModBus Lonworks, N2, BacNet MS/TP or BacNet IP shall be available as an optional accessory.
8. The boiler control system shall be capable of accepting 0-10VDC remote external analog signal to control the temperature set point.
9. The control system shall be capable of resetting the set point based on outdoor air temperature with the optional outside air temperature sensor (field installed).
10. The control shall monitor flue gas temperature and stop the boiler if the temperature is excessive.
11. The boiler safety control shall be furnished with controls for low gas pressure and high gas pressure, water pressure and low water cut off. Each module within the boiler shall be furnished with the following safety control devices which if in alarm shall not affect the normal operation of other modules within the boiler, blocked flue, blocked condensate, water temperature high limit, stack limit, water flow meter and temperature rise limiter.
12. The control shall graphically show the firing rate of each module in the boiler and each boiler in the cascade.
13. The boiler control software shall have the capability to be upgraded via USB stick.
14. The control shall be capable of switching its mode to operate from an internal setpoint if its external control signal is lost.
15. The boiler shall display service reminder notifications.

G. Casing: The frame shall be made of extruded aluminum alloy (EN AW-6060) and finished with a baked enamel powder coat (RAL7016). The panels shall be made of 18 and 22 gauge carbon steel and finished with a baked enamel powder coat (RAL9006).

H. Characteristics and Capacities:
1. See drawings for model selection

I. Electrical Characteristics:
1. See drawings for model selection.

2.3 TRIM

A. Include devices sized to comply with ANSI B31.9, "Building Services Piping."

B. Safety Relief Valve: ASME rated.

C. Boiler Air Vent: Automatic.

D. Drain Valve: Minimum NPS 3/4 (DN 20) hose-end gate valve.

E. Remote Contacts:
   1. Accepts enable / disable signal from BAS.
   2. Accepts 0-10vDC signal from BAS for temperature setpoint.
   3. Contacts for Boiler Fault.
   4. Boiler shall be supplied with a gateway for communicating with BAS via Modbus, BacNet, N2.

2.4 ELECTRICAL POWER

A. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in Division 26 Sections.

B. Single-Point Field Power Connection: Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to boiler.

2.5 VENTING

A. HVAC Contractor shall install owner furnished venting, complete UL approved positive pressure venting system
   1. ASTM A 959, Type AL29-4C stainless steel double wall pipe, vent terminal, thimble, indoor plate, vent adapter, condensate trap and dilution tank, and sealant.
   2. UL-1738 single walled, factory-built type, flame resistant polypropylene.

B. Combustion-Air Intake: Complete system, pipe, vent terminal with screen, inlet air coupling, and sealant. Inlet screen to be no less than 1” mesh.

C. Boiler Venting Guideline must be followed.

D. Installing contractor must develop and detailed and fully dimensioned sketch of each boiler venting route from outlet of boiler to final termination. Sketch must be emailed to Chris Pierson at RM Cotton (cpierson@rmcotton.com) so a completed bill of material can be developed and an installation drawing can be generated. Once the installation drawing is approved by the installing contractor, venting will be ordered. General venting lead-time is 8-10 weeks after an order is placed.

2.6 SOURCE QUALITY CONTROL

A. Test and inspect factory-assembled boilers, before shipping, according to ASME Boiler and Pressure Vessel Code.

PART 3 - EXECUTION

3.1 BOILER INSTALLATION

A. Installation shall be performed by the contractor in accordance with the requirements of the applicable codes and manufacturer’s instructions. Contractor shall review the boiler and installation for compliance with requirements and/or issues that may affect boiler performance. Installation should not proceed until unsatisfactory conditions have been corrected.

B. Install boilers level on concrete base at a height above the floor as required by boiler manufacturer's recommendation for proper condensate drainage and boiler operation. Concrete base is specified in Division 23 Section "Common Work Results for HVAC", and concrete materials and installation requirements are specified in Division 03.

C. Install gas-fired boilers according to NFPA 54 and ANSI Z223.1.

D. Assemble and install boiler trim and electrical devices furnished with boiler but not specified to be factory mounted.

E. Install electrical devices furnished with boiler but not specified to be factory mounted.

F. Install control wiring to field-mounted electrical devices.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 & Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping above boiler to allow required clearances for service and maintenance.

C. Piping:
1. Each boiler shall be provided with all necessary inlet and outlet connections. Refer to specific Boiler's specification sheet for connection sizes. Piping installation requirements are specified in other Division 23 Sections such as Section 23 20 00 "HVAC Piping and Pumps". Drawings indicate general arrangement of piping, fittings, and specialties.
2. Check manufacturer's installation manual for clearance dimensions and install piping adjacent to boiler to allow service and maintenance.
3. Install piping from condensate drain connection to nearest floor drain. Piping shall be at least full size of connection and adhere to proper codes for neutralization. Provide an isolation valve if required. Use PVC, CPVC, stainless steel, aluminum or polypropylene for condensate drain piping. DO NOT use carbon or copper components.
4. Connect gas piping to boiler gas train inlet with unions. Piping shall be at least full size of gas train connection. Provide gas pressure regulator if necessary.
5. Furnish and Install flue venting kit and combustion-air intake.
6. Connect full size to boiler connections.
7. Furnish and Install flue venting kit and combustion-air intake.
8. Connect full size to boiler connections.
9. Furnish and Install flue venting kit and combustion-air intake.
10. Connect full size to boiler connections.

D. Install electrical devices furnished with boiler but not specified to be factory mounted.

E. Install control wiring to field-mounted electrical devices.

F. Flush & clean boiler upon completion of installation in accordance with manufacturer's instructions. Boiler must be isolated when any cleaning or testing of the system piping is being performed.

G. Fill boiler system with water and required glycol and chemical treatment in order to satisfy manufacturer's water quality requirements.

H. Bleed air from boiler water lines and gas lines.

I. Perform hydrostatic test and fix leaks as necessary.

J. Check for proper water flow direction.

K. After all installation requirements have been accomplished, contractor shall fill out and return manufacturer's pre-startup form and return to boiler representative to schedule startup.

L. Install piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection. Provide an isolation valve if required.

M. The Plumbing Contractor shall connect gas piping to boiler gas-train inlet with union. Piping shall be at least full size of gas train connection. Provide a reducer if required. Boilers furnished with external gas regulators. Boilers must be piped such that there is a minimum of ten (10) feet straight length piping between the downstream side of the external regulator and elbow down to boiler – no exceptions. Refer to boiler installation manual for further details.

N. Connect hot-water piping to supply- and return-boiler tappings with shutoff valve and union or flange at each connection.

O. Install piping from safety relief valve common piping at bottom of boiler to nearest floor drain.

P. Boiler Venting (furnished by owner and installed by HVAC Contractor):
   1. Install boiler furnished Heat Fab adapter and combustion-air intake.
   2. Connect full size to boiler connections, but transition to larger sizes as shown on contract documents..

Q. Ground equipment according to Division 26 Section "Grounding and Bonding."

R. Connect wiring according to Division 26 Section "Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Coordinate boiler start-up with Chris Pierson at RM Cotton Company (651-248-9693). A Representative from Riello will perform boiler start-up. A minimum advanced notice of twenty-one (21) days is required prior to boiler start-up to schedule with all parties.:
   1. After all installation requirements have been accomplished, respective contractor(s) shall complete a boiler pre-start-up checklist provided by RM Cotton Company and email completed form to Chris Pierson at RM Cotton Company (cpierson@rmcotton.com) a minimum of five (5) business days prior date of boiler start-up. Boilers will not be started until RM Cotton Company receives the completed pre-start-up checklist. Installing contractor responsible for all expenses incurred for additional boiler start-up site visits if the pre-start-up checklist is not completed accurately and/or boilers or system are not fully ready for start-up on scheduled start-up day.
   2. Confirm boilers are installed properly per manufacturer's requirements
   3. A factory representative from Riello will perform combustion analysis multiple firing rates from low to high fire and adjust boiler settings as required for proper operation.

B. A factory representative from Riello will train Owner's maintenance personnel as specified below:
   1. Operate boiler, including accessories and controls, to demonstrate compliance with requirements.
   2. Procedures and schedules related to start-up and shutdown, troubleshooting, servicing, and preventive maintenance.

3. Review data in the maintenance manuals. Refer to Division 1 Section “Contract Closeout” AND “Operation and Maintenance Data”.
4. Training will occur the same day as boiler start-up. A minimum advanced notice of twenty-one
5. (21) days is required prior to scheduling owner’s training.

END OF SECTION 23 5216

SECTION 23 5700

HEAT EXCHANGERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Gasketed-plate heat exchangers.

1.2 DEFINITIONS

A. TEMA: Tubular Exchanger Manufacturers Association.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

   1. Include rated capacities, operating characteristics, and furnished specialties and accessories.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

   1. Design Calculations: Calculate requirements for selecting seismic restraints and for designing bases.
   2. Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment.

C. Delegated Design Submittal: Details and design calculations for seismic restraints for heat exchangers.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Equipment room plan or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.

B. Seismic Qualification Data: Certificates, for heat exchanger, accessories, and components, from manufacturer.

   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Heat Exchanger: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of heat exchanger anchorage devices on which certification is based and their installation requirements.

C. Product Certificates: For each type of shell-and-tube heat exchanger. Documentation that shell-and-tube heat exchangers comply with "TEMA Standards."

D. Source quality-control reports.

E. Field quality-control reports.

F. Sample Warranty: For manufacturer's warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For heat exchangers to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design seismic restraints for heat exchangers.

B. Seismic Performance: Heat exchangers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
2. Component Importance Factor is 1.0.

2.2 GASKETED-PLATE HEAT EXCHANGERS

A. Manufacturer:
1. Taco

B. Configuration: Freestanding assembly, consisting of frame support, top and bottom carrying and guide bars, fixed and movable end plates, tie rods, individually removable plates, and one-piece gaskets. Floor-mounted heat exchangers must have integral legs with mounting feet.

C. Construction: Fabricate and label heat exchangers to comply with ASME Boiler and Pressure Vessel Code, Section VIII, "Pressure Vessels," Division 1.

D. Frame:

1. Capacity to accommodate 20 percent additional plates.
2. Painted carbon steel with provisions for anchoring to support.

E. Top and Bottom Carrying and Guide Bars: Painted carbon steel, aluminum, or stainless steel.

1. Fabricate attachment of heat-exchanger support bars and guide bars with reinforcement strong enough to resist heat-exchanger movement during seismic event when heat-exchanger support bars and guide bars are anchored to building structure.

F. End-Plate Material: Painted stainless steel.

G. Tie Rods and Nuts: Steel or stainless steel.

H. Plate Material: 0.024 inch thick before stamping; Titanium.

I. Gasket Materials: Nitrile rubber.

J. Piping Connections: Factory fabricated of materials compatible with heat-exchanger shell. Attach tappings to shell before testing and labeling.

1. NPS 2 and Smaller: Threaded ends in accordance with ASME B1.20.1.
2. NPS 2-1/2 and Larger: Flanged ends in accordance with ASME B16.5 for steel and stainless steel flanges and in accordance with ASME B16.24 for copper and copper-alloy flanges.

K. Enclose plates in solid stainless steel removable shroud.

2.3 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect heat exchangers in accordance with ASME Boiler and Pressure Vessel Code, Section VIII, "Pressure Vessels," Division 1. Affix ASME International label.

B. Hydrostatically test heat exchangers to minimum of one and one-half times pressure rating before shipment.

C. Heat exchangers will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas for compliance with requirements for installation tolerances and for structural rigidity, strength, anchors, and other conditions affecting performance of heat exchangers.

B. Examine roughing-in for heat-exchanger piping to verify actual locations of piping connections before equipment installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF HEAT EXCHANGER, GENERAL

A. Equipment Mounting:

1. Install floor-mounted heat exchangers on cast-in-place concrete equipment bases. Install all heat exchangers level and plumb in accordance with manufacturer's recommendations. Install floor-mounted and wall-hung steam heat exchangers at sufficient height, using sufficient length supports, to achieve required steam and

condensate pipe pitch. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."

2. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

3.3 INSTALLATION OF GASKETED-PLATE HEAT EXCHANGER

A. Install wall-mounted gasketed-plate heat exchanger on custom-designed wall supports anchored to structure as indicated on Drawings.

B. Install floor-mounted gasketed-plate heat exchangers on cast-in-place concrete equipment base, and fasten legs to base.

C. Install metal shroud over installed gasketed-plate heat exchanger in accordance with manufacturer's written instructions.

3.4 PIPING CONNECTIONS

A. Comply with requirements for piping specified in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Comply with requirements for steam and condensate piping specified in Section 232213 "Steam and Condensate Heating Piping" and Section 232216 "Steam and Condensate Heating Piping Specialties."

C. Maintain manufacturer's recommended clearances for tube removal, service, and maintenance.

D. Install piping adjacent to heat exchangers to allow space for service and maintenance of heat exchangers. Arrange piping for easy removal of heat exchangers.

E. Install shutoff valves at heat-exchanger inlet and outlet connections.

F. Install pressure-relief valves on heat-exchanger shells where a connection has been provided on shell. When no shell pressure-relief valve connection has been provided, install pressure-relief valve on shell outlet piping before any isolation valves.

G. Install pressure-relief valves on heat-exchanger tube outlet piping before any isolation valves.

H. Pipe pressure-relief valves, full size of valve connection, to floor drain.

I. Install vacuum breaker at heat-exchanger steam inlet connection.

J. Install hose end valve to drain shell.

K. Install thermometer on each heat-exchanger fluid inlet and outlet piping. Comply with requirements for thermometers specified in Section 230500 "Common Work Results for HVAC."

L. Install pressure gauges on each heat-exchanger fluid inlet and outlet piping and steam inlet piping. Comply with requirements for pressure gauges specified in Section 230500 "Common Work Results for HVAC."

3.5 CLEANING

A. After completing system installation, including outlet fitting and devices, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes.

B. Isolate heat exchangers from piping before flushing piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blind flanges in flanged joints to isolate equipment.

C. Flush heat-exchanger piping systems with clean water; then remove and clean or replace strainer screens before reopening flow to heat exchangers.

3.6 FIELD QUALITY CONTROL

A. Testing Agency, Owner: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Agency, Contractor: Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Heat exchanger will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

3.7 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain heat exchangers.

END OF SECTION 23 5700

SECTION 23 7223.29

PACKAGED, OUTDOOR, FIXED PLATE ENERGY RECOVERY UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes custom packaged, outdoor, central-station air-handling units (rooftop units) with the following components and accessories:
   1. Direct-expansion cooling.
   2. Plate to plate heat exchanger.
   3. Gas furnace.
   4. Economizer outdoor- and exhaust-air damper section.
   5. Integral, space temperature controls.
   6. Roof curbs.

B. The term "Custom" means the unit shall take on the length, shape, aspect ratio, maximum weight, connection location and sizes, maintenance and access provisions, construction materials, cabinet ratings, and internal component performance, size and standard of quality as described on plans, schedules and as specified.

C. Related Requirements:

   1. Section 237343.16 "Outdoor, Semi-Custom Air-Handling Units" for outdoor, semi-custom air-handling units if they also include coils, other than electric coils for frost control, in addition to fixed-plate heat exchangers.

1.2 ACTION SUBMITTALS

A. Product Data:

   1. For each type of product.

      a. Include packaged, outdoor, fixed-plate, energy-recovery-unit rated capacities, operating characteristics, furnished specialties, and accessories.
      b. Fans:

         1) Certified fan-performance curves with system operating conditions indicated.
         2) Certified fan-sound power ratings.
         3) Fan construction and accessories.
         4) Motor ratings, electrical characteristics, and motor accessories.

B. Shop Drawings: For packaged, outdoor, fixed-plate, energy-recovery units.

   1. Include plans, elevations, sections, details, and mounting details.
   2. Include details of equipment assemblies. Indicate dimensions, weights, loads, lifting requirements, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Include diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, roof plans, elevations, and other details, drawn to scale. and coordinated with each other, using input from installers of items involved.

B. Seismic Qualification Data: Certificates, for packaged, outdoor, fixed-plate, energy-recovery units, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which certification is based and their installation requirements.

C. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For packaged, outdoor, fixed-plate, energy-recovery equipment to include in maintenance manuals.

1.5 COORDINATION

A. Coordinate sizes and locations of building openings and duct connections with actual equipment provided.

1.6 WARRANTY

A. General Warranty: The manufacturer shall submit a written warranty agreeing to repair or replace components that fail in materials or workmanship within the specified warranty period.
1. Provide manufacturer's parts warranty on the entire unit and all components contained within for one (1) year. The warranty period shall begin at start up or six (6) months after shipment, whichever occurs first.

B. Special Warranty: The manufacturer shall submit a written warranty agreeing to repair or replace components that fail in materials or workmanship within the specified warranty period.
1. Furnace: Twenty (20) year non-prorated parts warranty shall be provided for all indirect gas furnace heat exchangers. The warranty period shall begin at start up or six (6) months after shipment, whichever occurs first.
2. Compressor: Five (5) years non-proratet parts warranty shall be provided for the compressors. The warranty period shall begin at start up or six (6) months after shipment, whichever occurs first.
3. Flat Plate: Ten (10) year non-prorated parts warranty shall be provided for all flat plate air-to-air heat exchangers. The warranty period shall begin at start up or six (6) months after shipment, whichever occurs first.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.

B. ASHRAE Compliance:

1. Applicable requirements in ASHRAE 62.1.
2. Capacity ratings for fixed-plate energy-recovery units shall comply with ASHRAE 84.

C. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1.

D. UL Compliance:

1. Packaged heat-recovery ventilators shall comply with requirements in UL 1815 or UL 1812.
2. Electric coils shall comply with requirements in UL 1995.

E. Seismic Performance: Packaged, outdoor, fixed-plate, energy-recovery units shall withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
2. Component Importance Factor: 1.0.

2.2 PACKAGED, OUTDOOR, FIXED-PLATE, SENSIBLE HEAT, ENERGY-RECOVERY UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Innovent

2.3 CASINGS

A. General Fabrication Requirements for Casings: Formed and reinforced double-wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.

B. Exterior Casing Material: Galvanized steel with factory-painted finish, with pitched roof panels and knockouts with grommet seals for electrical and piping connections and lifting lugs.
1. Exterior Casing Thickness: 0.0626 inch (1.6 mm) thick.

C. Inner Casing Fabrication Requirements:
1. Inside Casing: Galvanized steel, 0.028 inch (0.7 mm) thick, perforated 40 percent free area.

D. Casing Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
1. Materials: ASTM C 1071, Type I.
2. Thickness: 1 inch (25 mm).
3. Liner materials shall have air-stream surface coated with an erosion- and temperature-resistant coating or faced with a plain or coated fibrous mat or fabric.

4. Liner Adhesive: Comply with ASTM C 916, Type I.

E. Condensate Drain Pans: Formed sections of galvanized-steel sheet, a minimum of 2 inches (50 mm) deep, and complying with ASHRAE 62.1-2004.
   1. Double-Wall Construction: Fill space between walls with foam insulation and seal moisture tight.
   2. Drain Connections: Threaded nipple.

2.4 FANS

A. Direct Drive Supply-Air Fans: Unhoused, plenum, backward curved, centrifugal: with permanently lubricated motor installed on an adjustable fan base resiliently mounted in the casing. Aluminum or painted-steel wheels, and galvanized- or painted-steel fan scrolls.

B. Condenser-Coil Fan: Propeller, mounted on shaft of permanently lubricated motor.

C. Relief-Air Fan: Forward curved, shaft mounted on permanently lubricated motor.

D. Seismic Fabrication Requirements: Fabricate fan section, internal mounting frame and attachment to fans, fan housings, motors, casings, accessories, and other fan section components with reinforcement strong enough to withstand seismic forces defined in Division 23 Section "Seismic Controls for HVAC" when fan-mounted frame and RTU-mounted frame are anchored to building structure.

E. Fan Motor: Comply with requirements in Division 23 Section "Common Motor Requirements For HVAC."

2.5 HEAT EXCHANGER

A. Construction: Flat plate air-to-air type to withstand 10” pressure differential and operate to 400 degree F. Plate corners sealed both mechanically and with sealant to prevent cross contamination.
   1. Air-to-air enthalpy wheels are not permitted.

B. Frame: Aluminum tube.

C. Plate Material: Completely smooth, 0.008” thick 99.5% pure aluminum.

D. Separators: Folded rib plate type spaced at 2 inch intervals for the full length of the plate.

E. Drains: Drain pans located beneath the exhaust and supply sides of the exchanger.

2.6 COILS

A. Supply-Air Refrigerant Coil:
   1. Aluminum-plate fin and seamless internally grooved copper tube in steel casing with equalizing- type vertical distributor.
   2. Coil Split: Interlaced.

B. Hot Gas Reheat Coil:
   1. Aluminum-plate fin and seamless internally grooved copper tube in steel casing with equalizing- type vertical distributor.

C. Outdoor-Air Refrigerant Coil:
   1. Aluminum-plate fin and seamless internally grooved copper tube in steel casing with equalizing- type vertical distributor.

2.7 REFRIGERANT CIRCUIT COMPONENTS

A. Number of Refrigerant Circuits: Refer to Schedule.

B. Compressor: Hermetic, scroll, mounted on vibration isolators; with internal overcurrent and high-temperature protection, internal pressure relief.

C. Refrigeration Specialties:
   1. Refrigerant: R-410A.
   2. Expansion valve with replaceable thermostatic element.
   3. Refrigerant filter/dryer.
   4. Manual-reset high-pressure safety switch.
   5. Automatic-reset low-pressure safety switch.
   6. Minimum off-time relay.
   7. Automatic-reset compressor motor thermal overload.
   8. Brass service valves installed in compressor suction and liquid lines.

2.8 AIR FILTRATION

A. Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
   1. Pleated: Minimum 90 percent arrestance, and MERV 13.

2.9 GAS FURNACE

A. Description: Factory assembled, piped, and wired; complying with ANSI Z21.47 and NFPA 54.
   1. CSA Approval: Designed and certified by and bearing label of CSA.

B. Burners: Stainless steel.
   1. Fuel: Natural gas.
   2. Ignition: Electronically controlled electric spark or hot-surface igniter with flame sensor.
   3. High-Altitude Model for Project elevations more than 2000 feet (610 m) above sea level.

C. Heat-Exchanger and Drain Pan: Stainless steel.

D. Venting: Gravity vented.

E. Safety Controls:
   1. Gas Control Valve: Modulating.
   2. Gas Train: Single-body, regulated, redundant, 24-V ac gas valve assembly containing pilot solenoid valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff.

2.10 DAMPERS

A. Outdoor- and Return-Air Mixing Dampers: Parallel- or opposed-blade galvanized-steel dampers mechanically fastened to cadmium plated for galvanized-steel operating rod in reinforced

cabinet. Connect operating rods with common linkage and interconnect linkages so dampers operate simultaneously.

1. Damper Motor: Modulating with adjustable minimum position.
2. Relief-Air Damper: Gravity actuated or motorized, as required by ASHRAE/IESNA 90.1-2004, with bird screen and hood.

2.11 ELECTRICAL POWER CONNECTION

A. A. Provide for single connection of power to unit with unit-mounted disconnect switch accessible from outside unit and control-circuit transformer with built-in overcurrent protection.

2.12 ACCESSORIES

A. Electric heater with integral thermostat maintains minimum 50 deg F (10 deg C) temperature in gas burner compartment.

B. Duplex, 115-V, ground-fault-interrupter outlet with 15-A overcurrent protection. Include transformer if required. Outlet shall be energized even if the unit main disconnect is open.

C. Filter differential pressure switch with sensor tubing on either side of filter. Set for final filter pressure loss.

D. Hail guards of galvanized steel, painted to match casing.

2.13 ROOF CURBS

A. Materials: Galvanized steel with corrosion-protection coating, watertight gaskets, and factory-installed wood nailer; complying with NRCA standards.
   1. Curb Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
      a. Materials: ASTM C 1071, Type I or II.
      b. Thickness: 2 inches (50 mm).
   2. Application: Factory applied with adhesive and mechanical fasteners to the internal surface of curb.
      a. Liner Adhesive: Comply with ASTM C 916, Type I.
      b. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.
      c. Liner materials applied in this location shall have air-stream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric depending on service air velocity.
      d. Liner Adhesive: Comply with ASTM C 916, Type I.

B. Curb Height: 18 inches (355 mm).

2.14 DDC SYSTEM

A. Manufacturer shall provide a programmable digital control system for each custom unit. A user terminal with LCD display shall provide capability of monitoring operation and changing setpoints through an integral keypad. The user terminal shall be unit mounted. The

manufacturer shall program the sequence of operation as specified in this section. The program shall include the following:

1. Unit start-up and shut-down requirements including fan/airflow proving indication and damper actuator end switch indication.
2. Temperature control for all heating and cooling devices.
3. Humidity control for all dehumidification devices and processes.
4. Economizers (dry-bulb, enthalpy, dewpoint, energy recovery) where applicable.
5. Fan controls for each mode of operation.
6. Defrost control for all energy recovery devices.
7. Requirements for modes of operation other than Occupied mode.
8. Integration of all optional devices (smoke detectors, pressure transducers, airflow stations, etc) specified within this section and on plan.
9. Alarms:
    a. Informational auto-reset alarms shall be provided and stored for all sensors, end devices, and components, and shall be accessible through the controller user interface.
    b. Manual reset alarms shall be provided and specified for optional devices (freezestats, smoke detectors, fan duct static pressure limits) and where required to protect the space served or the equipment.
    c. A list of standard alarms available to the BAS shall be included in the points list as specified in this section.

B. The controller shall communicate with the Building Automation System through factory provided BACnet MS/TP interface.

C. The controller shall have the capability through a web-based User Interface to remotely monitor all inputs/outputs, control the user terminal, view status of all alarms included both alarm and cleared time stamps, remotely upload a new program, and view historical and live log data for the past 24 hours. The controller shall save the data log for a rolling 7 days in a csv file that can be downloaded, with the additional capacity of storing 31 days of logged data to an external thumb drive.

D. Alarm Indication. DDC controller shall have one digital output for remote indication of an alarm condition. Alarm indication shall be configurable to indicate only shut down alarms if desired. The type of alarm shall be distinguishable through the BMS.

E. The equipment manufacturer shall provide the following refrigeration system compressor protections:
    1. Cycle Time (minimum OFF and minimum ON).
    2. High Saturated Discharge Temperature.
    3. Low Saturated Suction Temperature.
    4. High Pressure Trip (manual reset).
    5. Low Pressure Trip.
    6. High Discharge Temperature.

F. Miscellaneous Controls:
    1. Filter pressure switches shall be provided across each filter rack.
    2. High limit duct static pressure switch

G. Sequence of Operation: Manufacturer shall provide the sensors required for the Sequence of Operation.

2.15 SEQUENCE OF OPERATION

A. Unoccupied Mode:
   1. Outside air heat exchanger face and bypass damper actuators are powered.
   2. Controller checks damper end switch status.
   3. Exhaust fan is enabled and starts after dampers open as proved by end switches.
   4. Supply fan shall be enabled and set to 50% balanced fan speed (adj) 15 sec (adj) after exhaust fan starts.
   5. Dehumidification, economizer, face and bypass damper, cooling and heating are enabled and operate per sequence below.
      a. Pool Unit: Heating enables when the return temperature drops below the unoccupied setpoint, 80°F (adj), to increase the return temperature. Heating will be disabled when the return temperature reaches the unoccupied setpoint + a differential, 80°F+5°F (adj).

B. Occupied Mode:
   1. Outside air heat exchanger face and bypass damper actuators are powered.
   2. Controller checks damper end switch status.
   3. Exhaust fan is enabled and starts after dampers open as proved by end switches.
   4. Supply fan is enabled and set to 100% balanced airflow 15 sec (adj) after exhaust fan starts.
   5. Dehumidification, economizer, face and bypass damper, cooling and heating are enabled and operate per sequence below.

C. Supply Fan:
   1. The Supply Fan shall be set to operate at the design airflow as scheduled.
      a. The Supply Fan variable speed function shall be used for manual field balancing.

D. Exhaust Fan:
   1. The exhaust fan VFD shall modulate to maintain the differential pressure between the served space and the adjacent space. The pressure setpoint shall be -0.040” wc (adj).

E. Outside Air Heat Exchanger Face & Bypass Damper:
   1. Economizer: The economizer will be locked when the outside air temp is < 40 °F -2 °F hysteresis (adj). The economizer is active only if the outside air temp is < supply temp setpoint. The outside air heat exchanger face & bypass dampers modulate (bypassing outside air around the heat exchanger) to maintain the room temperature setpoint (see setpoints below).
   2. Defrost: The outside air heat exchanger face & bypass dampers modulate (bypassing outside air around the heat exchanger) to maintain the exhaust air temperature above freezing (setpoint = 34 °F).
   3. Energy Recovery: When defrost and economizer functions are inactive, the outside air heat exchanger face damper will be full open and outside air heat exchanger bypass damper will be full closed. All outside air passes through the heat exchanger.
      a. When the unit is de-energized both dampers (face & bypass) close, to shut off outside air when the unit is de-energized.

F. Cooling:
   1. Economizer Mode: The economizer (energy recovery reduction type) and mechanical cooling are controlled to maintain the supply temperature setpoint. The economizer, if available, will be used as the first stage of cooling.
      a. Outside air temperature < return air temperature -2°F:
         1) The outside air heat exchanger face and bypass dampers modulate (bypassing outside air around the heat exchanger) to maintain the supply temperature setpoint.
      b. Outside air temperature > return air temperature:

1) Heat exchanger face and bypass dampers are in full face position (all air passed through heat exchanger).

G. Cooling Mode:
1. Pool Unit: The compressors are activated to maintain the discharge air temperature setpoint.
2. Workout Floor Unit: The compressors are activated to maintain the discharge air temperature setpoint. The leaving air temperature is automatically reset up/down (between 50°F and 58°F, -2°F hysteresis (adj)) to maintain the room relative humidity setpoint, 55% RH (adj).
3. Lockout: The mechanical cooling shall be locked out when the outside air temperature is less than 50 °F (adj).

H. Heating:
1. Heating mode: The indirect gas fired furnace is controlled to maintain the supply temperature setpoint.
   a. Heat exchanger face and bypass dampers are in full face position (all air passed through heat exchanger).
2. Lockout:
   a. Pool Unit: The heating will be locked out when the outside air is >90+2°F hysteresis (adj).
   b. Workout Floor Unit: The heating will be locked out when the outside air is >50+2°F hysteresis (adj).

I. Dehumidification (Pool Unit):
1. Stage 1:
   a. The outside air and recirculation dampers modulate to maintain return dew point setpoint:
   b. 72.8°F (adj).
   c. When the outside air damper is at its maximum position, the recirculation air damper is at its minimum position, and the exhaust fan variable speed is at maximum exhaust (+/- space pressure offset)
2. Stage 2:
   a. Maximum outside air shall be maintained while the direct expansion coil is energized for return dew point control (outside air damper is in its maximum position and recirculation air damper is in its minimum position).
   b. The cooling is controlled to maintain the direct expansion coil leaving air temperature setpoint.
   c. When the direct expansion coil is activated for dehumidification, the unit controller will reset the DX coil leaving air temperature set point up/down between the values listed below to maintain the return dew point setpoint.
      1) Dehumidification coil leaving minimum set point is 61°F (adj).
      2) Dehumidification coil leaving maximum set point is 72.8°F (adj).
   d. Hot Gas Reheat is controlled to maintain the supply temperature set point between the cooling minimum and heating maximum supply setpoints.
3. If heating is active and unable to maintain the unit supply temperature setpoint, the dehumidification damper control loop shall be limited to minimum position.

J. Supply Temperature Set Point:
1. The controller will reset the supply temperature setpoint up/down to between the values listed below in order to maintain the room temperature setpoint:
   a. The controller will reset the supply temperature setpoint up/down to between the values listed below in order to maintain the room temperature setpoint:
      1) Supply heating temperature minimum setpoint: 80°F (adj)
      2) Supply heating temperature maximum setpoint: 130°F (adj)

3) Supply cooling minimum setpoint: equal to the current return dew point + 2°F (adj).
4) Supply cooling maximum setpoint: 88°F

b. Workout Floor Unit:
1) Supply discharge minimum set point: 50°F (adj)
2) Supply discharge maximum set point: 58 °F (adj)
3) Supply discharge set point in winter mode: 63°F (adj)

K. Source Limitations: Obtain packaged, outdoor, fixed-plate, energy-recovery units from single manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine casing insulation materials and filter media before packaged, outdoor, fixed-plate, energy-recovery unit installation. Replace insulation materials and filter media that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF PACKAGED, OUTDOOR, FIXED-PLATE, ENERGY-RECOVERY UNITS

A. Install packaged, outdoor, fixed-plate, energy-recovery units, so supply and exhaust airstreams flow in opposite directions.

1. Install access doors in both supply and exhaust ducts, both upstream and downstream, for access to interior components.
2. Install removable panels or access doors between supply and exhaust ducts on building side for bypass during startup.
3. Access doors and panels are specified in Section 233300 "Air Duct Accessories."

B. Equipment Mounting:

1. Install packaged, outdoor, fixed-plate, energy-recovery units on [**4-inch**] <**Insert dimension**> cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
2. Install roof-mounted packaged, outdoor, fixed-plate, energy-recovery units on manufacturer's-recommended-height equipment roof curbs. Comply with requirements for equipment curbs specified in Section 077200 "Roof Accessories."
3. Comply with requirements for vibration-isolation and seismic-control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
4. Comply with requirements for vibration-isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

C. Suspended Units: Suspend and brace units from outdoor structural-steel support frame, using threaded steel rods and spring hangers. Comply with requirements for vibration-isolation devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

D. Install units with clearances for service and maintenance.

E. Do not operate equipment fans until temporary or permanent filters are in place. Replace temporary filters used during construction and testing with new, clean filters prior to final inspection.

3.3 DUCTWORK CONNECTIONS

A. Comply with requirements for ductwork in accordance with Section 233113 "Metal Ducts."

B. Connect duct to units with flexible connections. Comply with requirements in Section 233300 "Air Duct Accessories."

C. Isolation Dampers: Install isolation dampers in accordance with Section 230923.12 "Control Dampers."

3.4 PIPING CONNECTIONS

A. Comply with requirements for piping specified in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to unit, allow for service and maintenance.

C. Connect piping to units mounted on vibration isolators with flexible connectors.

D. Condensate Drain Piping: See Section 232113 "Hydronic Piping" for pipe type. Install condensate drain piping from drain pans to nearest floor drain, same size as condensate drain connection.

1. Construct deep trap at connection to drain pan, and install cleanouts at changes in direction.

3.5 ELECTRICAL CONNECTIONS

A. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.

B. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."
2. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

3.6 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring in accordance with Section 260523 "Control-Voltage Electrical Power Cables."

3.7 STARTUP SERVICE

A. Engage factory-authorized service representative to perform startup service.

1. Complete installation and startup checks in accordance with manufacturer's written instructions.

3.8 ADJUSTING

A. Adjust moving parts to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust initial temperature and humidity setpoints.

C. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

3.9 FIELD QUALITY CONTROL

A. Testing Agency:

1. Owner will engage a qualified testing agency to perform tests and inspections.
2. Engage qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections with assistance of factory-authorized service representative.

D. Tests and Inspections:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Packaged, outdoor, fixed-plate, energy-recovery units will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

3.10 DEMONSTRATION

A. Engage factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air-to-air energy-recovery units.

END OF SECTION 23 7223.29

SECTION 23 7416.13

PACKAGED, LARGE-CAPACITY, ROOFTOP AIR-CONDITIONING UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Packaged, large-capacity, rooftop air-conditioning units including:

   a. Direct-expansion cooling.
   b. Gas furnace.
   c. Economizer outdoor- and return-air damper section.
   d. Integral, space temperature controls.
   e. Roof curbs.

B. Related Requirements:

1. Section 018123 "Facility Seismic and Wind Criteria" specifies basis-of-design seismic and wind criteria for nonstructural components.

1.2 DEFINITIONS

A. RTU: Rooftop unit. As used in this Section, this abbreviation means packaged, outdoor, central-station air-handling units. This abbreviation is used regardless of whether the unit is mounted on the roof or on a concrete base on ground.

B. Supply-Air Fan: The fan providing supply-air to conditioned space. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

C. Supply-Air Refrigerant Coil: Refrigerant coil in the supply-air stream to absorb heat (provide cooling) during cooling operations and to reject heat (provide heating) during heating operations. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus..

1.3 ACTION SUBMITTALS

A. Product Data: For each RTU.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.
3. Include unit dimensions and weight.
4. Include cabinet material, metal thickness, finishes, insulation, and accessories.
5. Fans:

   a. Include certified fan-performance curves with system operating conditions

indicated.
b. Include certified fan-sound power ratings.
c. Include fan construction and accessories.
d. Include motor ratings, electrical characteristics, and motor accessories.

6. Include certified coil-performance ratings with system operating conditions indicated.
7. Include filters with performance characteristics.
8. Include gas furnaces with performance characteristics.
9. Include factory selection calculations for each antimicrobial UV lamp installation.
10. Include dampers, including housings, linkages, and operators.

B. Shop Drawings: For each packaged, large-capacity, rooftop air-conditioning unit.

1. Include plans, elevations, sections, and [**mounting**][**attachment**] details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans and other details, or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.

B. Seismic Qualification Data: Certificates, for RTUs, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
4. Restraint of internal components.

C. Product Certificates: Submit certification that specified equipment will withstand wind forces identified in Section 230548 "Vibration and Seismic Controls for HVAC" and Section 018123 "Facility Seismic and Wind Criteria."

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculations.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of wind force and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Source quality control reports.

E. System startup reports.

F. Field quality control reports.

G. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For RTUs.

1.6 WARRANTY

A. General Warranty: The manufacturer shall submit a written warranty agreeing to repair or replace components that fail in materials or workmanship within the specified warranty period.

1. Provide manufacturer's parts warranty on the entire unit and all components contained within for one (1) year. The warranty period shall begin at substantial completion.

B. Special Warranty: The manufacturer shall submit a written warranty agreeing to repair or replace components that fail in materials or workmanship within the specified warranty period.

1. Compressors: Five (5) years non-prorated warranty shall be provided for the compressors. The warranty period shall begin at substantial completion.
2. Gas Furnace: Ten (10) years non-prorated warranty shall be provided for all gas furnace heat exchangers. The warranty period shall begin at substantial completion.
3. Solid-State Ignition Modules: Three (3) years non-prorated warranty shall be provided for all solid-state ignition modules. The warranty period shall begin at substantial completion.
4. Control Boards: Three (3) years non-prorated warranty shall be provided for all unit control boards. The warranty period shall begin at substantial completion.
5. Variable Frequency Drives: Five (5) years non-prorated warranty shall be provided all variable frequency drives. The warranty period shall begin at substantial completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of RTUs and components.

C. ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and Startup."

D. ASHRAE 15 Compliance: For refrigeration system safety.

E. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

F. UL Compliance: Comply with UL 1995.

2.2 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements called for in the schedules located on the plans.

1. Basis of design:

    a. Lennox Industries

2. Alternate Manufacturers: Deduct pricing shall be noted in the bid for any alternate manufacturer submitted.

    a. JCI/York
    b. Daikin Applied
    c. Aaon
    d. Carrier

B. Manufacturers: Subject to compliance with requirements called for in the schedules located on the plans.

1. Single Zone: Lennox Industries
2. Variable Air Volume: Daikin Applied

2.3 CASINGS

A. General Fabrication Requirements for Casings: Formed and reinforced double-wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.

B. Exterior Casing Material: Galvanized steel with factory-painted finish, with pitched roof panels and knockouts with grommet seals for electrical and piping connections and lifting lugs.

1. Exterior Casing Thickness: 0.0626 inch (1.6 mm) thick.

C. Inner Casing Fabrication Requirements:

1. Inside Casing: Galvanized steel, 0.028 inch (0.7 mm) thick, perforated 40 percent free area.

D. Casing Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.

1. Materials: ASTM C 1071, Type I.
2. Thickness: 1 inch (25 mm).
3. Liner materials shall have air-stream surface coated with an erosion- and temperature-resistant coating or faced with a plain or coated fibrous mat or fabric.
4. Liner Adhesive: Comply with ASTM C 916, Type I.

E. Condensate Drain Pans: Formed sections of galvanized-steel sheet, a minimum of 2 inches (50 mm) deep, and complying with ASHRAE 62.1-2004.

1. Double-Wall Construction: Fill space between walls with foam insulation and seal moisture tight.
2. Drain Connections: Threaded nipple.
3. Pan-Top Surface Coating: Corrosion-resistant compound.

F. Airstreams Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2007.

1. Pan-Top Surface Coating: Corrosion-resistant compound.

G. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

2.4 FANS

A. Belt-Driven Supply-Air Fans: Double width, forward curved, centrifugal; with permanently lubricated, single-speed motor installed on an adjustable fan base resiliently mounted in the casing. Aluminum or painted-steel wheels, and galvanized- or painted-steel fan scrolls.

B. Condenser-Coil Fan: Propeller, mounted on shaft of permanently lubricated motor.

C. Relief-Air Fan: Forward curved, shaft mounted on permanently lubricated motor.

D. Seismic Fabrication Requirements: Fabricate fan section, internal mounting frame and attachment to fans, fan housings, motors, casings, accessories, and other fan section components with reinforcement strong enough to withstand seismic forces defined in 23 Section "Seismic Controls For HVAC" when fan-mounted frame and RTU-mounted frame are anchored to building structure.

E. Fan Motor: Comply with requirements in Division 23 Section "Common Motor Requirements For HVAC."

2.5 COILS

A. Supply-Air Refrigerant Coil:

1. Aluminum-plate fin and seamless internally grooved copper tube in steel casing with equalizing- type vertical distributor.
2. Coil Split: Interlaced.
3. Condensate Drain Pan: Galvanized steel with corrosion-resistant coating formed with pitch and drain connections complying with ASHRAE 62.1-2007.
4. Condensate Drain Pan: Galvanized steel with corrosion-resistant coating formed with pitch and drain connections complying with ASHRAE 62.1-2004.

B. Outdoor-Air Refrigerant Coil:

1. Aluminum-plate fin and seamless internally grooved copper tube in steel casing with equalizing- type vertical distributor.

C. Hot-Gas Reheat Refrigerant Coil:

1. Aluminum-plate fin and seamless internally grooved copper tube in steel casing with equalizing- type vertical distributor.
2. Polymer strip shall prevent all coper coil from contacting steel coil frame or condensate pan.

2.6 REFRIGERANT CIRCUIT COMPONENTS

A. Number of Refrigerant Circuits: Refer to Schedule.

B. Compressor: Hermetic, scroll, mounted on vibration isolators; with internal overcurrent and high-temperature protection, internal pressure relief.

C. Refrigeration Specialties:

1. Refrigerant: R-410A.
2. Expansion valve with replaceable thermostatic element.
3. Refrigerant filter/dryer.
4. Manual-reset high-pressure safety switch.
5. Automatic-reset low-pressure safety switch.
6. Minimum off-time relay.
7. Automatic-reset compressor motor thermal overload.
8. Brass service valves installed in compressor suction and liquid lines.
9. Low-ambient kit high-pressure sensor.
10. Hot-gas reheat solenoid valve with a replaceable magnetic coil.
11. Hot-gas bypass solenoid valve with a replaceable magnetic coil.

2.7 AIR FILTRATION

A. Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.

1. Pleated: Minimum 90 percent arrestance, and MERV 13.

2.8 GAS FURNACE

A. Description: Factory assembled, piped, and wired; complying with ANSI Z21.47 and NFPA 54.

1. CSA Approval: Designed and certified by and bearing label of CSA.

B. Burners: Stainless steel.

1. Fuel: Natural gas.
2. Ignition: Electronically controlled electric spark or hot-surface igniter with flame sensor.
3. High-Altitude Model for Project elevations more than 2000 feet (610 m) above sea level.

C. Heat-Exchanger and Drain Pan: Stainless steel.

D. Venting: Gravity vented.

E. Safety Controls:

1. Gas Control Valve: Modulating.
2. Gas Train: Single-body, regulated, redundant, 24-V ac gas valve assembly containing pilot solenoid valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff.

2.9 DAMPERS

A. Outdoor- and Return-Air Mixing Dampers: Parallel- or opposed-blade galvanized-steel dampers mechanically fastened to cadmium plated for galvanized-steel operating rod in reinforced cabinet. Connect operating rods with common linkage and interconnect linkages so dampers operate simultaneously.

1. Damper Motor: Modulating with adjustable minimum position.
2. Relief-Air Damper: Gravity actuated or motorized, as required by ASHRAE/IESNA 90.1-

2004, with bird screen and hood.

2.10 ELECTRICAL POWER CONNECTION

A. Provide for single connection of power to unit with unit-mounted disconnect switch accessible from outside unit and control-circuit transformer with built-in overcurrent protection.

2.11 CONTROLS

A. Manufacturer shall provide a programmable digital control system for each unit. A user terminal with digital display shall provide capability of monitoring operation and changing setpoints through an integral keypad. The user terminal shall be unit mounted. The manufacturer shall program the sequence of operation as specified in this section.

1. All unit controls shall be hardwired, wireless controls are not permitted.
2. Basic Unit Controls:

    a. Wall-Mounted combination thermostat/humidistat sensor with the following features:
    b. Heat-cool-off switch.
    c. Fan on-auto switch.
    d. Fan-speed switch.
    e. Automatic changeover.
    f. Adjustable deadband.
    g. Data entry and access port to input temperature and humidity set points, occupied and unoccupied periods, and output room temperature and humidity, supply air temperature, operating mode, and status.

B. The unit mounted controller shall communicate with the Building Automation System through factory provided BACnet interface. The BACnet interface shall include a interface relay for scheduled operation. The BACnet interface shall have the following features:

1. Adjusting set points.
2. Monitoring supply fan start, stop and operation.
3. Inquiring data to include outdoor-air damper position, supply and room air temperature.
4. Monitoring occupied and unoccupied operations.

C. Additional Monitoring:

1. Constant and variable motor loads.
2. Variable frequency drive operation.
3. Economizer cycle.
4. Cooling load.
5. Air distribution static pressure and ventilation air volumes (VAV units).

D. Alarm Indication: The BACnet interface shall include an interface relay to provide indication of fault and store diagnostic code information to the BAS.

E. Provide return air mounted Carbon Dioxide (CO2) detector as noted in schedule to control outdoor air damper.

F. Provide dehumidification control on units as noted in schedule on plan.

G. Provide discharge air sensor and pressure transducer for VAV operation as noted on plan and in schedules.

2.12 ACCESSORIES

A. Electric heater with integral thermostat maintains minimum 50 deg F (10 deg C) temperature in gas burner compartment.

B. Duplex, 115-V, ground-fault-interrupter outlet with 15-A overcurrent protection. Include transformer if required. Outlet shall be energized even if the unit main disconnect is open.

C. Filter differential pressure switch with sensor tubing on either side of filter. Set for final filter pressure loss.

D. Hail guards of galvanized steel, painted to match casing.

2.13 ROOF CURBS

A. Materials: Galvanized steel with corrosion-protection coating, watertight gaskets, and factory-installed wood nailer; complying with NRCA standards.

1. Curb Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.

    a. Materials: ASTM C 1071, Type I or II.
    b. Thickness: 2 inches (50 mm).

2. Application: Factory applied with adhesive and mechanical fasteners to the internal surface of curb.

    a. Liner Adhesive: Comply with ASTM C 916, Type I.
    b. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.
    c. Liner materials applied in this location shall have air-stream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric depending on service air velocity.
    d. Liner Adhesive: Comply with ASTM C 916, Type I.

B. Curb Height: 18 inches.

C. Wind and Seismic Restraints: Metal brackets (Hurricane Clips) compatible with the curb and casing, painted to match RTU, used to anchor unit to the curb, and designed for loads at Project site. Comply with requirements in Division 23 Section "Seismic Control For HVAC" for wind-load requirements.

2.14 SEQUENCE OF OPERATION – SINGLE ZONE STAGED AIR VOLUME ROOFTOP PACKAGE UNIT

A. Occupied Mode:

1. The Supply Fan, Exhaust Fan, DX Cooling, Gas Heating, Economizer, Dehumidification,

and Demand Controlled Ventilation: shall be enabled and operate per defined sequences below.

B. Unoccupied Mode:

1. The Supply Fan, Exhaust Fan, DX Cooling, Gas Heating, Economizer, Dehumidification, and Demand Controlled Ventilation: shall be enabled and maintain unoccupied temperature setpoints.

C. Supply Fan:

1. The Supply Fan speed shall be fixed to the required percentage of maximum setpoint for each of the following modes;

a. DX Cooling Stage #1
b. DX Cooling Stage #2
c. DX Cooling Stage #3
d. DX Cooling Stage #4
e. Gas Heating Mode
f. Ventilation Mode

D. Exhaust fan:

1. TAB shall determine return air static pressure and associated CFM of installed system for comparison to manufacturers printed literature.
2. The Exhaust Fan shall be commanded to run when the Outside Air Damper position is 10% greater than the listed power exhaust fan performance to maintain positive buidling pressurization.

E. DX Cooling:

1. The mechanical cooling shall stage compressors to maintain the space temperature at the Zone Cooling Setpoint.

a. The cooling setpoint shall be set at 55°F (adj).

2. Lockout: The mechanical cooling shall be locked out when the outside air temperature is less than 45.0 °F (adj).

F. Heating:

1. The gas-fired heating shall stage burners to maintain the space temperature at the Zone Heating Setpoint.

a. The heating setpoint shall be set at 90°F (adj).

2. Lockout: The heating shall be locked out when the outside air temperature is greater than 45.0 °F (adj).

G. Economizer:

1. The Economizer shall be active when the outdoor enthalpy is below the ODE Setpoint and there is a cooling demand. The Economizer shall modulate the outside air damper and return air damper to maintain the supply air temperature.
2. When not active, the Economizer shall modulate outside air damper the minimum

position.

H. Dehumidification:

1. The Dehumidification shall be active when the Space Relative Humidity is greater than the Zone RH Setpoint. The compressors and hot-gas reheat shall be modulated to maintain supply air temperature.

I. Demand Control Ventilation (DCV):

1. The DCV shall modulate the outside air and return air dampers from minimum position to maximum position based on space carbon dioxide concentration.The damper shall start to open at 800 PPM (adj).

2.15 SEQUENCE OF OPERATION – VARIABLE AIR VOLUME ROOFTOP PACKAGED UNIT

A. Occupied Mode:

1. The Supply Fan, Exhaust Fan, DX Cooling, Gas Heating, Economizer, Dehumidification, and Demand Controlled Ventilation: shall be enabled and operate per defined sequences below.

B. Unoccupied Mode:

1. The Supply Fan, Exhaust Fan, DX Cooling, Gas Heating, Economizer, Dehumidification, and Demand Controlled Ventilation: shall be enabled and maintain unoccupied temperature setpoints.

C. Supply Fan:

1. The Supply Fan shall modulate to maintain the supply air static pressure at the Supply Air Static Pressure Setpoint.

D. Exhaust fan:

1. TAB shall determine return air static pressure and associated CFM of installed system for comparison to manufacturers printed literature.
2. The Exhaust Fan shall be commanded to run when the Outside Air Damper position is 10% greater than the listed power exhaust fan performance to maintain positive buidling pressurization.

E. DX Cooling:

1. The mechanical cooling shall stage compressors to maintain the supply air temperature at the Supply Air Temperature Setpoint as defined by section 25 95 00 paragraph 2.02.

a. The cooling setpoint shall be set at 55°F (adj).

2. Lockout: The mechanical cooling shall be locked out when the outside air temperature is less than 45°F (adj).

F. Heating:

1. The gas-fired heating shall stage burners to maintain the supply air temperature at the

Supply Air Temperature Setpoint as defined by section 25 95 00 paragraph 2.02.

a. The unit shall change to heating mode at an outside air temperature below 45°F (adj).

2. Lockout: The heating shall be locked out when the outside air temperature is greater than 60°F (adj).

G. Economizer:

1. The Economizer shall be active when the outdoor enthalpy is below the ODE Setpoint and there is a cooling demand. The Economizer shall modulate the outside air damper and return air damper to maintain the mixed air temperature at the Mixed Air Temperature Setpoint (adj).
2. When not active, the Economizer shall modulate the outside air damper to the minimum position.

H. Dehumidification:

1. The Dehumidification shall be active when the Space Relative Humidity is greater than the Zone RH Setpoint. The compressors shall be modulated to maintain supply air temperature at the Supply Air Temperature Setpoint.
2. The Supply Air Temperature Setpoint shall be overridden to a value of two (2) °F below the current return air dew point. The override shall be released when the mode is not active.

I. Demand Control Ventilation (DCV):

1. The DCV shall modulate the outside air and return air dampers from minimum position to maximum position based on space carbon dioxide concentration. The damper shall start to open at 800 PPM (adj).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of RTUs.

B. Examine roughing-in for RTUs to verify actual locations of piping and duct connections before equipment installation.

C. Examine roofs for suitable conditions where RTUs will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF PACKAGED, LARGE-CAPACITY, ROOFTOP AIR-CONDITIONING UNITS

A. Roof Curb: Install on roof structure or concrete base, level and secure, in accordance with [**NRCA's "NRCA Roofing Manual: Membrane Roof Systems."**][**AHRI Guideline B.**] Install RTUs on curbs and coordinate roof penetrations and flashing with roof construction specified in

Section 077200 "Roof Accessories." Secure RTUs to upper curb rail, and secure curb base to roof framing or concrete base with anchor bolts. Coordinate sizes and locations of roof curbs with actual equipment provided.

1. Install normal-weight, **3000 psi**, compressive strength (28-day) concrete mix inside roof curb, 4 inches thick. Concrete, formwork, and reinforcement are specified with concrete.

B. Unit Support: Install unit level on structural curbs. Coordinate wall penetrations and flashing with wall construction. Secure RTUs to structural support with anchor bolts.

C. Equipment Mounting:

1. Install RTUs on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
2. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
3. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

3.3 PIPING CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to RTU, allow space for service and maintenance.

C. Connect piping to unit mounted on vibration isolators with flexible connectors.

D. Connect condensate drain pans using NPS 1-1/4, **ASTM B88, Type M** copper tubing. Extend to nearest equipment or roof drain. Construct deep trap of indicated depth at connection to drain pan and install cleanouts at changes in direction.

E. Gas Piping: Comply with applicable requirements in Section 231123 "Facility Natural-Gas Piping." Connect gas piping to burner, full size of gas train inlet, and connect with union and shutoff valve with sufficient clearance for burner removal and service.

F. Hot- and Chilled-Water Piping: Comply with applicable requirements in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties." Install shutoff valve and union or flange at each coil supply connection. Install balancing valve and union or flange at each coil return connection.

G. Steam and Condensate Piping: Comply with applicable requirements in Section 232213 "Steam and Condensate Piping" and Section 232216 "Steam and Condensate Heating Piping Specialties." Install shutoff valve at steam supply connections, float and thermostatic trap, and union or flange at each coil return connection. Install gate valve and inlet strainer at supply connection of dry steam humidifiers, and inverted bucket steam trap to condensate return connection.

H. Refrigerant Piping: Comply with applicable requirements in Section 232300 "Refrigerant Piping." Install shutoff valve and union or flange at each supply and return connection.

3.4 DUCT CONNECTIONS

A. Comply with duct installation requirements specified in other HVAC Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:

1. Install ducts to termination at top of roof curb.
2. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.
3. Connect supply ducts to RTUs with flexible duct connectors specified in Section 233300 "Air Duct Accessories."
4. Install return-air duct continuously through roof structure.

3.5 ELECTRICAL CONNECTIONS

A. Connect electrical wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.

D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

1. Nameplate is to be laminated acrylic or melamine plastic signs as specified in Section 260553 "Identification for Electrical Systems."
2. Nameplate is to be laminated acrylic or melamine plastic signs as layers of black with engraved white letters at least **1/2 inch** high.
3. Locate nameplate where easily visible.

3.6 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring in accordance with Section 260523 "Control-Voltage Electrical Power Cables."

3.7 CLEANING

A. After completing system installation and testing, adjusting, and balancing RTUs and air-distribution systems, clean RTUs internally to remove foreign material and construction dirt and dust. Clean fan wheels, cabinets, dampers, coils, and filter housings, and install new, clean filters.

3.8 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks in accordance with manufacturer's written

instructions.

2. Inspect for visible damage to unit casing.
3. Inspect for visible damage to furnace combustion chamber.
4. Inspect for visible damage to compressor, coils, and fans.
5. Inspect internal insulation.
6. Verify that labels are clearly visible.
7. Verify that clearances have been provided for servicing.
8. Verify that controls are connected and operable.
9. Verify that filters are installed.
10. Clean all coils and inspect for construction debris.
11. Clean furnace flue and inspect for construction debris.
12. Connect and purge gas line.
13. Remove packing from vibration isolators.
14. Inspect operation of barometric relief dampers.
15. Verify lubrication on fan and motor bearings.
16. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
17. Adjust fan belts to proper alignment and tension.
18. Start unit in accordance with manufacturer's written instructions.

    a. Start refrigeration system.
    b. Do not operate below recommended low-ambient temperature.
    c. Complete startup sheets and attach copy with Contractor's startup report.

19. Inspect and record performance of interlocks and protective devices; verify sequences of operation.
20. Operate unit for an initial period as recommended or required by manufacturer.
21. Perform the following operations for both minimum and maximum firing. Adjust burner for peak efficiency.

    a. Measure gas pressure on manifold.
    b. Inspect operation of power vents.
    c. Measure combustion-air temperature at inlet to combustion chamber.
    d. Measure flue-gas temperature at furnace discharge.
    e. Perform flue-gas analysis. Measure and record flue-gas carbon dioxide and oxygen concentration.
    f. Measure supply-air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.

22. Calibrate thermostats.
23. Adjust and inspect high-temperature limits.
24. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
25. Start refrigeration system and measure and record the following when ambient is a minimum of **15 deg F** above return-air temperature:

    a. Coil leaving-air, dry- and wet-bulb temperatures.
    b. Coil entering-air, dry- and wet-bulb temperatures.
    c. Outdoor-air, dry-bulb temperature.
    d. Outdoor-air-coil, discharge-air, dry-bulb temperature.

26. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
27. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.

    a. Supply-air volume.
    b. Return-air volume.

c. Relief-air volume.
d. Outdoor-air intake volume.

28. Simulate maximum cooling demand and inspect the following:

    a. Compressor refrigerant suction and hot-gas pressures.
    b. Short circuiting of air through condenser coil or from condenser fans to outdoor-air intake.

29. Verify operation of remote panel including pilot-light operation and failure modes. Inspect the following:

    a. High-temperature limit on gas-fired heat exchanger.
    b. Low-temperature safety operation.
    c. Filter high-pressure differential alarm.
    d. Economizer to minimum outdoor-air changeover.
    e. Relief-air fan operation.
    f. Smoke and firestat alarms.

30. After startup and performance testing and prior to Substantial Completion, replace existing filters with new filters.

3.9 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for air-handling system testing, adjusting, and balancing.

C. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. After installing RTUs and after electrical circuitry has been energized, test units for compliance with requirements.
2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
5. RTU will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.11 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain RTUs.

END OF SECTION 23 7416.13

SECTION 25 0800

COMMISSIONING OF BUILDING AUTOMATION SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes specific requirements that apply to the implementation of the Commissioning Process and this Division Contractors' participation in this process. This section details the project specific equipment and systems that are included in the Commissioning Process. For general descriptions and responsibilities, refer to SECTION 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

1.2 RELATED DOCUMENTS

A. The Owner's Project Requirements (OPR) document.

B. The Basis of Design (BoD) document.

C. The Project Commissioning Plan (CxP) document.

D. ASHRAE Standard 202-2013 - Commissioning Process for Buildings and Systems.

E. LEED v4 for Building Design and Construction.

1.3 RELATED SECTIONS

A. SECTION 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS

B. SECTION 07 08 00 - COMMISSIONING OF THERMAL AND MOISTURE PROTECTION

C. SECTION 08 08 00 - COMMISSIONING OF OPENINGS

D. SECTION 11 08 00 - COMMISSIONING OF EQUIPMENT

E. SECTION 13 08 00 - COMMISSIONING OF SPECIAL CONSTRUCTION

F. SECTION 14 08 00 - COMMISSIONING OF CONVEYING SYSTEMS

G. SECTION 21 08 00 - COMMISSIONING OF FIRE SUPPRESSION SYSTEMS

H. SECTION 23 08 00 - COMMISSIONING OF MECHANICAL SYSTEMS

I. SECTION 25 08 00 - COMMISSIONING OF INTEGRATED AUTOMATION SYSTEMS

J. SECTION 26 08 00 - COMMISSIONING OF ELECTRICAL SYSTEMS

K. SECTION 27 08 00 - COMMISSIONING OF COMMUNICATIONS SYSTEMS

L. SECTION 28 08 00 - COMMISSIONING OF SAFETY AND SECURITY SYSTEMS

M. SECTION 33 08 00 - COMMISSIONING OF UTILITIES

1.4 DEFINITIONS

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

1.5 RESPONSIBILITIES

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

PART 2 - PRODUCTS

2.1 NO PRODUCTS SUPPLIED

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

B. Contractors and/or Vendors shall provide the specialty testing equipment necessary to fulfill the functional testing requirements, for the duration of the testing period.

PART 3 - EXECUTION

3.1 GENERAL

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.2 MEETINGS

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.3 SYSTEM START-UP

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.4 PRE-FUNCTIONAL CHECKLISTS

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.5 FUNCTIONAL PERFORMANCE TESTING

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.6 TRAINING

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.7 SYSTEMS TO BE COMMISSIONED

A. GENERAL
   1. Commissioning specifications supplements the requirements of individual specifications sections but shall not be interpreted to replace or diminish the specified scope of any individual section.
   2. For all systems listed below, Division Contractor shall comply with all commissioning requirements specified.

B. APPLICABLE SYSTEMS
   1. Graphical User Interface
   2. Network Servers
   3. Network Server Software
   4. Third-Party Integration Systems
   5. Protocol Gateways
   6. Network Supervisory Controllers
   7. Unitary Controllers
   8. Field Devices
   9. Automation Software
   10. Sequence of Operations

END OF SECTION 25 0800

SECTION 25 1000

BUILDING AUTOMATION SYSTEM – NETWORK SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes control equipment and components for a complete Building Automation System (BAS), including control components for terminal heating and cooling units not supplied with factory-wired controls as well as integration of factory-wired controls.

B. Materials covered by this Section are to be purchased direct from the supplier unless noted otherwise. This contractor shall review and adjust shop drawings as necessary, coordinate shipping dates, receive products on the job site, store the product until installation and shall install the product as if it had been purchased by the contractor.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

C. Division 01, 13, 14, 21, 22, 23, 26, 27, and 28 Specification Sections, apply to this Section.

D. Life Time Fitness “Owner’s Project Requirements” document.

E. Section 23 09 34 – VARIBLE FREQUENCY DRIVES

F. Section 25 20 00 - BAS INSTRUMENTATION

G. Section 25 30 00 - BAS TERMINATIONS

H. Section 25 90 00 - BAS SEQUENCE OF OPERATIONS

1.3 REFERENCE STANDARDS

A. Comply with all current codes, ordinances, regulations for the jurisdiction having authority.

B. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

C. ASHRAE Standard 90.1 - Energy Standard for Buildings

D. ASHRAE Standard 62.1 - Ventilation for Acceptable Indoor Air Quality

E. ASHRAE Standard 135 - BACnet - A Data Communication Protocol for Building Automation and Control Networks

F. ASHRAE Standard 135.1 - Method of Test for Conformance to BACnet

G. ASHRAE Standard 41.8 - Standard Methods for Liquid Flow Measurement

H. ASHRAE Standard 202 - Commissioning Process for Buildings and Systems

I. ASHRAE Guideline 36-2021 - High-Performance Sequences of Operation for HVAC Systems

J. IECC - International Energy Conservation Code

K. ICC 2018 International Green Construction Code

L. UL 916: Energy Management Systems

M. NFPA 70: The National Electrical Code.

N. ISA-5.1: Instrumentation Symbols and Identification.

1.4 DEFINITIONS

A. BACnet: A data communication protocol defined by ASHRAE Standard 135.

B. BACnet/IP: Annex J of Standard 135 for transmission of BACnet messages over TCP/IP networks.

C. BAS: Building Automation System.

D. DDC: Direct Digital Control.

E. Gateway: Communication hardware and/or software for translating two different protocols.

F. I/O: Input/Output.

G. Workstation: A computer PC where the personnel operating the building DDC systems can interface with the systems and adjust setpoints and operating conditions.

H. MS/TP: Master Slave / Token Passing.

I. Native BACnet Device: A BACnet system that uses BACnet devices at all levels and communicates without the need for intermediary gateways.

J. PID: Proportional, integral, derivative control loop algorithm.

K. Router: A component that joins two or more networks using different LAN technologies.

L. RTD: Resistance temperature device.

M. Server: A computer on which the DDC operating system interfaces with controllers and the internet.

1.5 SCOPE OF WORK

A. This project requires the installation of a new Building Automation System constructed using a Niagara Framework with BACnet Field Level Devices. These devices, design, installation drawings, programming, and startup services shall be provided by Honeywell Multisite using the OPUS Magnum a Niagra based framework. The BAS shall utilize [one or multiple] JACE controllers, networked with a Niagara Framework Supervisor and compatible field devices.
   1. In the event multiple JACE controllers are used one JACE shall be designated as primary and all graphics/interface shall be through the primary unit.

B. The Contractor will be required to perform the following:
   1. Furnish, install, configure and commission a new Niagara Framework with BACnet fully programmable and application specific DDC controllers for the equipment identified in the DI drawings, including all components, software and applications required to meet the sequence of operation and the design/performance intent of the systems.
   2. Provide Application Specific Controllers (ASCs) and Programmable Control Units (PCUs) as specified herein and as indicated on the DI drawings. Provide I/O and ancillary devices as specified herein, as indicated on the DI drawings, and as necessary to perform the sequences of operation. If any devices are required to achieve the specified sequence of operation and not specified on the drawings or specifications the controls contractor should include that equipment in their bid. Provide BACnet or Niagara Framework products that communicate on MS/TP or TCP/IP channels to meet the functional specifications.
   3. Furnish and install electronic energy meters to monitor energy usage and measure the efficiency of energy use within the facility as indicated on the DI drawings.
   4. Furnish and install all low voltage step-down transformers with associated low voltage connections, power supplies and power/communication/input/output cabling necessary for the control system.
   5. Furnish and install conduit, junction boxes, fittings, panels, enclosures, and hardware as specified in these specifications, on the drawings and as required by Code.
   6. Provide Graphical User Interface Development for all of the devices identified above and illustrated within the DI drawings.
   7. It is the contractor's responsibility to review all of the design documents and specifications and report any discrepancies to the owner.

1.6 GENERAL INSTALLATION

A. Contractor shall implement a Niagara Framework based open system that will allow products from various suppliers to be integrated into a unified system to provide flexibility for expansion, maintenance, and service of the system. The Owner shall be the named license holder of all software associated with any and all incremental work on the project.

B. The Owner shall receive ownership of all job specific configuration documentation; data files and application-level software developed for the project. This shall include all custom, job specific software code, databases and documentation for all configuration and programming that is generated for a given project and/or configured for use with the NAC, FMCS Server(s), and any related LAN / WAN / Intranet and Internet connected routers and devices. All required IDs and passwords for admin and programming level access to any component or software program shall be provided to the Owner.

C. It is the Owner's intent to purchase an open system capable of being serviced and expanded by any acceptable system integrator that has and maintains certification (TCP) to work on Niagara Framework systems

D. All hardware and field level devices installed, (i.e., ASCs, PDUs), for the project shall not be limited in their ability to communicate with a specific brand of Niagara Framework device. They

should also be constructed in a modular fashion to permit the next generation and support components to be installed in place of or in parallel with existing components.

E. Provide and install all wiring required for a complete system, including communication bus, analog points, digital points, low voltage power, emergency power, and spare communication bus. Splices are not permitted within the IAS FAC LAN or DLN communication cables. Only continuous bus topologies, MS/TP or continuous homeruns are allowed for these networks. Capacity of any bus shall be limited to 80% of the allowable device count to allow for future minor modifications or expansions to the network.

F. Provision of all documentation called out in these specifications including, but not limited to, submittals, O&M manuals, commissioning submittals, CAD based as-built documentation, and training manuals. Provide electronic files on electronic media.

G. Training of facility personnel, and or maintenance contractor, on the operation and maintenance of the system. Refer to [Section 3.11] for further training requirements.

H. The repair of all finished surfaces effected because of BAS related installation work. This includes but is not limited to carpet, drywall, paint, ceiling tiles, furniture, and the like.

I. System point to point check out, verification and documentation. Assist the Owner/LTF CxM, and/or TAB Firm in verification and functional performance testing and GUI acceptance testing. Refer to 25 08 00 for further requirements.

J. Graphical User Interface Development. The Contractor shall develop the graphics, tools, features, and network integration as required.

1.7 CONTROL DIAGRAMS AND SCHEDULE

A. The automation diagrams and schedules are an integral part of the control system design. Together the specifications, design drawings and schedules will provide a complete design. It is important that these documents be completed to a level of detail that will enable performance expectations for the project to be realized.

B. Refer to BAS and Mechanical, Design and As-Built Drawings for information on the components and intended control functions.

1.8 SEQUENCE OF OPERATIONS

A. Program each Niagara Framework Network Controller, and third-party ASC, PCU, device, etc., to perform the sequences of operation provided in Section 25 90 00 SEQUENCE OF OPERATIONS and the DI drawings. Provide all necessary hardware on each piece of equipment for the equipment to perform the specified sequence and to meet the requirements of the point lists.

B. The Contractor shall be responsible for all control wiring connections, auxiliary devices and control wiring diagrams to complete the control system and attain the described sequence of operation.

C. The Contractor shall coordinate a review of the RTU’s setup configurations with the Mechanical Contractors start up representative prior to the configuration of the units.

1.9 BUILDING AUTOMATION SYSTEM POINTS LIST

A. Refer to the DI drawings for all equipment points which should be included in the graphic interface.

B. Alarms shall be provided as indicated on the matrix.

1.10 PARTS LIST

A. As part of the submittal, provide an accurate parts list including manufacturer, model number and quantity for all hardware and software.

1.11 QUALITY ASSURANCE

A. Provide a Niagara Framework as the basis of the new BAS. The Contractor shall be fully certified in the development and customization of the Niagara Framework software.

B. All microprocessor-based control products used shall conform to BTL Certified communication standards and Niagara Framework.

C. The BAS and components shall be listed by Underwriters Laboratories (UL 916) as an Energy Management System.

D. Functionality and Completeness: Contractor shall furnish and install all hardware, software and programming necessary to provide a complete and functioning system as specified. Contractor shall include all hardware, software and programming not specifically itemized in these Specifications, which is necessary to implement, maintain, operate, and diagnose the system in compliance with these Specifications.

1.12 INSTALLER'S QUALIFICATIONS

A. Installer's Qualifications: The Contractor shall have a successful history in the design and installation of Niagara Framework based Building Automation Systems to provide web browser monitoring and control of BACnet field level devices. Contractor must demonstrate experience in BAS installations for not less than 5 years and in DDC installation projects with point counts equal to this Project and systems of the same character as this Project.

B. Installer's Experience with Proposed Product Line: Firms shall have specialized in and be experienced with the installation of the proposed product line for not less than one year from date of final completion on at least three (3) projects of similar size and complexity. Submittals shall document this experience with references. Provide evidence of Niagara TCP certification as part of the submittal process.

1.13 BID PACKAGE SUBMITTAL

A. Provide the following submittals as part of the bid package.
   1. Proposed device schedule including all hardware and software.
   2. Qualifications.
   3. One-line diagram indicating how the new Niagara Framework network controllers will integrate with any existing BAS BACnet field level devices.
   4. An overall sequence of the construction as it pertains to the installation of the Building Automation System.

1.14 SUBMITTALS

A. General: Submit under provisions of Division 01.

B. Electronic Submittals: BAS control submittals and operation and maintenance (O&M) information shall be provided in electronic format as follows:
   1. Drawings and Diagrams:
      a. Shall be provided in .PDF Format.
      b. Product Data Sheets shall be provided in .PDF Format.

C. Qualifications: Manufacturer, Installer, and Key personnel qualifications as indicated for the appropriate items.

D. Submit a list of no less than three similar projects, which utilize the Niagara Framework for Enterprise connectivity to provide an Integrated Automation System that consists of web-browser control and monitoring of the proposed BACnet field level devices. These projects must be on-line and functional such that representatives from the Owner can observe the Integrated Automation System and Interface in full operation. Include proper references and contact numbers of these reference projects.

E. Submit validation which indicates the successful completion of the Niagara Framework TCP certification course.

F. Submit resumes of installing staff indicating passing certificates for training on the BACnet and Tridium TCP certification line of controls to be installed as part of this project.

G. Product Data: Submit manufacturer's technical product data for each Niagara Framework based Network Controller, control device, sensor, actuator, relay, panel, and accessory furnished, indicating dimensions, capacities, performance and electrical characteristics, and material finishes. Also include installation and start-up instructions.

H. Products: Within twenty-one (21) days after date of execution of Sub-Contractor agreement, submit for acceptance a list of all material and equipment manufacturers whose products are proposed, as well as names of all subcontractors whom the Contractor proposes to employ.

I. Submit documentation indicating BACnet Testing Laboratories (BTL) compliance and include Protocol Implementation Conformance (PIC) Statements.

J. Submit Shop Drawings for each control system.

K. Control Logic Documentation:
   1. Provide a written description of each control sequence.
   2. Submit a BAS Start-Up Test Agenda and Schedule for review and approval.

L. As-Built Record Documents:
   1. Provide record copies of product data and control Shop Drawings updated to reflect the final installed condition.
   2. Record documents shall include panel layout diagrams including wiring terminal connections. This should be on a 42x30 pdf drawing.
   3. Accurately record actual set points and settings of controls, final sequence of operation, including changes to programs made after submission and approval of Shop Drawings and including changes to programs made during specified testing.
   4. Record copies shall include individual floor plans with device (controllers, routers, sensors, etc.) locations with all interconnecting wiring routing including space sensors, LAN wiring, power wiring, low voltage power wiring.

5. Network Riser Diagram including controller addresses.
6. Valve Schedule including: Tag, system served, line size, flow rate (GPM), valve size, type of connection, valve type, flow pattern, supply power, manufacturer, valve and actuator part numbers, fail position, design coefficient, trim material.

1.15 SYSTEM ARCHITECTURE

A. The system provided shall incorporate hardware and software resources sufficient to meet the functional requirements of these Specifications. The Facility Local Area Network (FAC LAN) and Device Level Network (DLN) shall be based on industry standard open platforms as specified herein and utilize commonly available operation, management and application software. All software packages and databases shall be licensed to the Owner to allow unrestricted maintenance and operation of the BAS. Contractor shall include all items not specifically itemized in these Specifications that are necessary to implement, maintain, and operate the system in compliance with the functional intent of these Specifications.

B. The system architecture shall expand on the existing BAS, which is based on the Niagara Framework and consists of an Ethernet-based, wide area network (WAN), a single Local Area Network (LAN) that supports NCs, PCUs, ASCs, Operator Workstations (OWS), Smart Devices (SD), and Remote Communication Devices (RCDs) as applicable.
   1. WAN: Internet-based network connecting multiple facilities with a central data warehouse and server, accessible via standard web-browser. This is an existing infrastructure and Contractor is not required to configure any components of this WAN.
   2. Facility Local Area Network (FAC LAN): The FAC LAN shall be an Ethernet-based, 1 GBS Ethernet LAN connecting Local NCs, IAS Server and OWSs. The FAC LAN serves as the backbone for the NCs communications path and as the connection point to the WAN. The Owner shall provide a FAC LAN for the control system. LAN shall be IEEE 802.3 Ethernet over Fiber or Category 6 cable with switches and routers that support Gigabit Ethernet throughput.
   3. Device Level Network (DLN): Network used to connect PCUs and ASCs. These shall be Master/Slave Token/Passing (MS/TP) devices as defined in the BTL standard. A maximum of 38.4k bps shall be utilized.
   4. ARCnet DLNs shall not be acceptable.
   5. LON Works based devices and/or technology is not acceptable.

C. Remote Data Access: The system shall support the Internet Browser-based remote access to the building data. The IAS contractor shall coordinate with the Owner's IT department to ensure all remote browser access (if desired by the owner) is protected with the latest Niagara Software updates and a VPN (Virtual Private Network) must be installed to protect the owner's network from cyber-attacks.

D. Browser-based access: A remote/local user using a standard browser will be able access all control system facilities and graphics via the WAN or direct connection, with proper username and password. Only native Internet browser-based user interfaces, HTML5, that do not require plug-ins (thin clients) are acceptable. The system shall be capable of supporting an unlimited number of clients using a standard Web browser such as Internet Explorer or Chrome.

E. Graphics: Graphics shall include all pieces of mechanical equipment with a dedicated graphics page showing all points as indicated on the DI drawings.

F. Niagara Framework Control Systems Server (CSS): A server that maintains the systems configuration and programming database. It shall allow secure multiple access to the control information.

G. The communication speed between the controllers shall set up to meet each manufacturer's requirements for polling time and data transmission.

H. Systems Configuration Database: The system architecture shall support maintaining the systems configuration database on a server that resides on the FAC LAN. User tools for DLN and FAC LAN management shall be provided and licensed to the Owner and shall allow unrestricted configuring, updating, maintaining, and expanding of all current devices, configurations and settings.

1.16 WARRANTY

A. The entire BAS and all ancillary equipment required for its operation shall be free from defects in workmanship and material under normal use and service. If within 12 months from the date of substantial completion the installed equipment is found to be defective in operation, workmanship or materials, the Contractor shall replace, repair or adjust the defect at no cost to the Owner.

B. The warranty period for work and systems of this project shall commence after functional performance testing is complete.

C. Corrective software modifications made during warranty service periods shall be updated on all user documentation and on user and manufacturer archived software disks.

D. The Owner reserves the right to make changes to the BAS during the Warranty Period. Such changes do not constitute a waiver of warranty. Contractor shall warrant parts and installation work regardless of any such changes made by Owner, unless the Contractor provides clear and convincing evidence that a specific problem is the result of such changes to the BAS.

E. At no cost to the Owner, during the Warranty Period, Contractor shall provide maintenance services for software including all current software updates, firmware and hardware PRODUCTS. Prior to the closeout of the warranty period, the BAS contractor shall meet with the owner's representative to address any questions or concerns and offer ongoing Software Maintenance Services to the owner.

F. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

1.17 STAND-ALONE FUNCTIONALITY

A. All controllers provided shall be capable of running standalone in the event of a loss of communications. Equipment fail position shall be set based on controls schematic.

B. Third party interfaces
   1. Manufacturer third party interfaces shall be limited to equipment which the BAS contractor cannot or has not been contracted to control directly via DDC controllers. This equipment shall include the following. Chillers, Boilers, ERUs, MAUs, VFDs, Utility Meters, Generators, Energy Monitors, Lighting Control Systems.

1.18 ENERGY MANAGEMENT APPLICATIONS

A. The BAS shall have the ability to perform energy management routines via preprogrammed function blocks or template programs.

1.19 UNIFORMITY

A. To the extent practical, all equipment of the same type serving the same function shall be identical and from the same manufacturer.

1.20 TEMPORARY NETWORK REQUIREMENTS

A. Temperature Control Contractor shall provide a temporary cellular connection to all JACE / Executive Controllers prior to setup of permanent Life Time Network. Connection shall be used to facilitate BAS installation, programming, checkout, commissioning, and test and balance in addition to any other required activities to meet the project schedule. Temperature Controls Contractor shall be responsible for providing all components required for connection and use of temporary network.
   1. Final connection to the Life Time Network shall be completed by the TCC once the building is active and online and prior to substantial completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:
   1. Niagara Framework version 4.10 or above.
   2. Life Time Property Development Approved Equal.

B. Acceptable Distributors:
   1. Honeywell Novar Multisite
      a. Phil McConnel (608.354.7350 / Philip.McConnell@Honeywell.com)
      b. Jason Nobbe (JNobbe@lt.life)
   2. Life Time Property Development Approved Equal.

C. Acceptable Integrators:
   1. Licensed Contractor, Corporate Facilities Operations approved.
   2. Life Time Property Development Approved Equal.

2.2 MATERIALS AND EQUIPMENT

A. Materials shall be new, the best of their respective kinds without imperfections or blemishes and shall not be damaged in any way. Used equipment shall not be used in any way for the permanent installation except where Drawings or Specifications specifically allow existing materials to remain in place.

2.3 SUBSTITUTIONS

A. Wherever the words “for review” or “for acceptance” are used in regard to manufactured specialties, or wherever it is desired to substitute a different make or type of apparatus for that specified, submit all information pertinent to the adequacy and adaptability of the proposed apparatus to the Owner and secure their approval before the apparatus is ordered. Refer to general condition requirements for substitutions.

PART 3 - EXECUTION

3.1 PREPARATION

A. Examine areas and conditions under which control systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

B. These specifications call out certain duties of the Contractor and any subcontractor. They are not intended as a material list of all items required by the Contract.

3.2 INSTALLATION

A. Utilize licensed installers and comply with Division 26 electrical specifications for conduit, junction box, and wiring requirements.

B. Provide related items and work indicated on the DI drawings and items and work called for in this Division of the Specifications. This includes all incidentals, equipment, appliances, services, hoisting, scaffolding, supports, tools, supervision, labor, consumable items, fees, licenses, etc., necessary to provide complete systems. Perform start up, configuration, programming and commissioning coordination on each control product and system to provide fully operable systems in accordance with the specified functional performance.

C. Installation shall be in accordance with manufacturer's published recommendations and shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

D. The DI drawings show the general arrangement of the respective systems. Follow these Drawings as closely as actual building construction and the work of other trades will permit. Provide devices, power, fittings, sensors, controllers, wiring and accessories, which may be required but are not shown on the Drawings or specified herein. The Contractor shall be responsible for achieving the sequence of operations and intent of the system design.

E. All installation shall be in accordance with manufacturer's published recommendations.

F. Limit LAN cable lengths to no longer than 80% of the longest dimension published by the manufacturer of the cable between the most remote network nodes.

G. Comply with all rules, guidelines and procedures defined by the Owner's IT authority.

3.3 DIGITAL CONTROL PANELS, CONTROLLER QUANTITY AND LOCATION

A. Individual Digital Control Panels (DCP) are referenced to indicate allocation of points to each DCP and DCP location. Digital control panels shall consist of one or multiple controllers to meet requirements of this Specification.

B. Contractor shall extend power to the DCP from an acceptable power panel (coordinate with Division 26).

3.4 NETWORK MANAGEMENT FUNCTIONAL REQUIREMENTS

A. Contractor shall thoroughly and completely configure BAS system control devices, software, supplemental software, application programming, network communications, CSS, OWS, and network communications to permit the functional requirements of the BAS herein specified. The setup shall include as a minimum, the following network management procedures:
   1. Automatic backup of the DDC System database to appropriate media.
   2. Program, load and debug all software installations, including integration of third-party applications (e.g. analytics and energy management).
   3. Network user auditing routine.

3.5 SURGE PROTECTION

A. Contractor shall furnish and install any power supply surge protection, filters, etc. as necessary for proper operation and protection of all NCs, routers and other hardware and interface devices. All equipment shall be capable of handling voltage variations 10 % above or below measured nominal value, with no effect on hardware, software, communications, and data storage.

3.6 CONTROL POWER SOURCE AND SUPPLY

A. BAS Contractor shall provide all power source wiring required for operation of all equipment and devices provided under Division 25 and the DI Drawings.

3.7 PRODUCT DELIVERY, STORAGE, HANDLING, PROTECTION AND CLEANING

A. All products and materials shall be new, clean, and free of defects, damage and corrosion.

B. Ship and store products and materials in a manner which will protect them from damage, weather, and entry of debris until final acceptance.

3.8 SITE CLEAN UP

A. At conclusion of each day's work, and at the request of the owner, clean up and remove from the site all rubbish, debris and trash accumulated during the day as a result of work of the Contractor.

B. Marks on walls or ceiling tiles caused by the Contractor shall be cleaned by the Contractor. Ceiling tiles, drywall, carpet, paint, and all architectural finishes damaged by the Contractor shall be replaced by the Contractor.

3.9 CHECK OUT (CCO) START-UP TESTING, ADJUSTING, CALIBRATION

A. Work and/or systems installed under this Division shall be fully functioning prior to Demonstration and Acceptance Phase. Contractor shall conduct the CCO which addresses the start-up, testing, adjustments, and calibrations of all work and/or systems under this Contract.

B. All CCO testing procedures shall be documented in the CCO report to be provided by the contractor to the Owner/LTF CxM.

3.10 SUMMARY OF IAS ACCEPTANCE PROCEDURE

A. Submit product data, Shop Drawings, logic documentation, and sample graphics to the Engineer of Record, and receive approval.

B. Install BAS. Obtain Owner/LTF CxM acceptance of each phase of installation when installation consists of a renovation in an occupied space.

C. Submit as-built record documents.

D. Provide the Owner/LTF CxM an agenda and schedule of CCO testing activities for approval and coordination.

E. Provide written notice that the system is ready for Functional Performance Testing (FPT). Schedule BAS Demonstrations and Owner/LTF CxM Commissioning.

F. Demonstrate BAS systems to Owner/Engineer. Perform Functional Performance Testing including sequence of operation, point to point verification to graphical interface, historical data logging, and alarms.

G. Owner/LTF CxM to provide detailed punch list to contractor.

H. Contractor to repair issues on Owner/LTF CxM punch list in seven (7) calendar days.

I. Contractor provides all usernames, passwords, software, GUI, databases, licenses, and application programming tool(s) to the Owner.

J. Contractor provides training to Owner on all aspects of the IAS including architecture, devices, software, final sequences, and modes of operation.

K. Revise and re-submit as-built record Drawings and O&M Manuals.

L. When Functional Performance Testing Final is complete and all record drawings, submittals, and O&M Manual are submitted this will constitute acceptance and the beginning of the warranty period.

3.11 TRAINING

A. Training Allowance: Provide add service for not less than eight (8) hours formal training to the Owner’s designated operations personnel.

B. Additional training shall be available for purchase and attendance by the Owner or designee. This additional training shall be of the same curriculum as the training courses provided by the manufacturer to the System Integrator.

C. Training shall not be provided unital after the completed installation and verified correct operation (FPT) by the owner’s third-party commissioning agent. Coordinate with GC for scheduled owner training.

D. Meet all applicable Training requirements of Division 01 and the following:

E. Instruct the operators how to accomplish control of the system. Include basic troubleshooting and override of equipment and controls in the event of system failure.

F. Trainers - Persons conducting the training shall be knowledgeable in the workings of the system, and shall be regularly engaged in training exercises, to provide effective training. Submit names and qualifications of trainers for Owner review prior to scheduling training.

G. Training Manuals - Include the following in training manuals.
   1. Completed FPT Procedure.
   2. “As-installed” Drawings.
   3. Manufacturer’s Operation Manuals.

END OF SECTION 25 1000

SECTION 25 2000

BUILDING AUTOMATION SYSTEM – INSTRUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes automation device requirements for whole facility automation, including subsystems and equipment.

1.2 RELATED DOCUMENTS

A. Section 23 09 34 - VARIABLE FREUENCY DRIVES

B. Section 25 10 00 - BAS NETWORK SYSTEMS

C. Section 25 30 00 - BAS TERMINATIONS

D. Section 25 90 00 - BAS SEQUENCE OF OPERATIONS

1.3 REFERENCE STANDARDS

A. Refer to Section 25 10 00 - BAS NETWORK SYSTEMS.

1.4 DEFINITIONS

A. Refer to Section 25 10 00 - BAS NETWORK SYSTEMS.

1.5 SCOPE OF WORK

A. Refer to Section 25 10 00 - BAS NETWORK SYSTEMS.

PART 2 - PRODUCTS

2.1 EQUIPMENT REQUIREMENTS

A. All equipment shall meet or exceed the requirements listed below. Equipment shown on the Process Automation drawings shall conform with this specification.

B. Temperature Sensors:
   1. Temperature Sensors provided by the equipment manufacturer shall meet manufacturer thermistor standards.
   2. Temperature Sensors provided by the controls contractor shall be 10k ohm Type III thermistors.

3. Temperature sensing elements shall be accurate within plus or minus 1.0 ºF over their expected sensing range for all applications.
4. Space Sensors shall be provided where shown on plans and shall be mounted above finished floor as directed by Architect. Provide wall guards as called for on plans. Refer to Installation section for further details.

C. Relative Humidity Sensors:
1. Relative humidity sensors shall be thin-film capacitance with accuracy of 2% over the 20% to 95% range for all applications.
2. All equipment sensors shall be provided by the equipment manufacturer where possible. If not possible, the output signal shall be 0-10 VDC, proportional over full range (4 to 20 mA as approved).

D. Cabon Dioxide Sensors:
1. Performance Criteria:
   a. Measurement Range: 0 to 2000 ppm.
   b. Accuracy: ±100 ppm.
   c. Repeatability: ±20 ppm.
   d. Drift: ±100 ppm per year.
   e. Output Signal: 0-10 VDC (4 to 20 mA as approved).
   f. Proportional signal over the full range.
2. Calibration Adjustments:
   a. Automatic zero compensation and span calibration.
   b. Minimum Adjustment Resolution: ±20 ppm.
   c. Recommended Calibration Interval: 3 years.
   d. Maximum Response Time: 60 seconds.
   e. Maximum Warm-Up Time: 15 minutes.

E. Outdoor Air Sensors:
1. Outdoor air, temperature, and humidity shall be provided to the BAS via National Oceanic and Atmospheric Administration (NOAA) weather stations. Contractor shall determine nearest weather station and submit recommended weather station for approval.

F. Analog Current Sensors:
1. Analog current sensor shall be loop powered, fully isolated. Sensor through-hole to accommodate appropriate wire size for specific application. Provide with over-range protection. Sensor shall provide accuracy of plus or minus 1.0% of full scale, linearity and repeatability of plus or minus 0.5% of full scale, and response time of no less than 300 milliseconds to 99 percent of full scale.

G. Power Monitors:
1. Power monitor provided by electrical contractor in electrical panel. Controls contractor shall integrate power monitor with building automation system.
2. Three-phase type with disconnect/shorting switch assembly, listed voltage and current transformers. Maximum 2% error at 1.0 power factor.
3. Provide Current Transformers rated for the nominal connected load.
4. Interface: Factory-installed hardware and software to enable the BAS to monitor, control, and display status and alarms and energy usage.
   a. Network Communications Ports: RS-485.
   b. Embedded Native Protocols for Network Communications: ASHRAE 135 BACnet protocol accessible via the communications port.

H. Pressure Transmitters:
1. Pressure Transmitters shall be solid state piezo resistive silicon suitable for the measured medium, range and pressures of that application, and shall have the following:
   a. Adjustable span and zero.

b. Accuracy of plus or minus 1.0% of span.
c. Linearity of plus or minus 0.1% of span.

I. Flow Meters – Natural Gas:
1. General:
a. Inline thermal mass flow meter specifically for natural gas with visual display.
b. Natural Gas Accuracy: ±1%.
c. Input Power: 12-28 VDC.
d. Ambient Temperature Range: -40ºF to 158ºF.
2. Interface: Factory-installed hardware and software to enable the IAS to monitor, control, and display status and alarms.
a. Network Communications Ports: RS-485.
b. Embedded Native Protocols for Network Communications: ASHRAE 135 BACnet protocol accessible via the communications port.

J. Flow Meters – Displacement-Type:
1. Description:
a. Standard: AWWA C700.
b. Pressure Rating: 150 psig working pressure.
c. Body Design: Nutating disc; totalization meter.
d. Registration: In gallons or cubic feet as required by service type.
e. Case: Bronze.
f. End Connections: Threaded.
2. Interface: Factory-installed hardware and software to enable the IAS to monitor, control, and display status and alarms.
a. Network Communications Ports: RS-485.
b. Embedded Native Protocols for Network Communications: ASHRAE 135 BACnet protocol accessible via the communications port.

K. Flow Meters – Hydronic:
1. Accuracy:
a. % of reading at calibrated velocity.
b. ±1% of reading for 3 to 30 ft/s (10:1 range).
c. ±2% of reading from 0.4 to 20 ft/s (50:1 range).
2. Output signals available
a. 0-10 VDC
3. Electronics enclosure
a. NEMA4 enclosure
4. Electrical connections
a. Standard: 10’ of cable with ½” NPT conduit connection
b. Optional: indoor DIN connector with 10’ of plenum rated cable

L. Pressure Switches – Dry:
1. Static or differential pressure switches shall have a repetitive accuracy of ±2% of their operating range and shall withstand up to 150 percent of rated pressure. Trip Reset shall be automatic for all applications except High or Low Static Safeties, in which case Manual Trip Reset is required.

M. Pressure Switches – Wet:
1. Static or differential pressure switches shall have a repetitive accuracy of ±2% of their operating range and shall withstand up to 150 percent of rated pressure. Actuation shall be adjustable over the operating pressure range. The switch shall have a snap-action dry contact rated for the application. Trip Reset shall be automatic.

N. Automation Cables:
1. Insulation:

a. 300 Volt Class.
2. All cable shall be twisted, shielded, plenum rated.
3. Wire Markers:
a. Include full wrap self-adhesive type labels on each cable end and on each terminated and un-terminated conductor.

O. O.Controls Cabinets:
1. 1. NEMA rating to match installed locations.
2. 2. Shall maintain Class 2 circuit requirements:
a. a. Maximum voltage: 90 Volts
b. b. Maximum power; 100 VA
3. 3. Front panel hinge and fitted with a key locking latch.
4. 4. Perforated backboard, supplied with enclosure.

P. Control Labels:
1. Type: Engraved, laminated plastic.
2. Location: All standalone control cabinets.
3. Minimum Size: 3/4” by 2-1/2”.
4. Text Color: White.
5. Background Color: Black.
6. Minimum Letter Size: 3/8” high.

Q. Raceways:
1. Products: As specified in Division 26.
2. Required Locations:
a. Wire and cable of this section shall be in conduit within any exposed spaces.

R. Relays and Contactors:
1. Relays: General purpose, latching, and time delay types, rated for application.
a. Contacts:
1) Type: Silver-cadmium. Form C.
2) Enclosure: Dustproof.
3) Life Span: One million operations.
b. Operating Time: 20 milliseconds or less.
c. Release Time: 10 milliseconds or less
2. Contactors: Single coil, electrically operated, mechanically held type, rated for application.
a. Contacts:
1) Type: Double break, silver to silver, protected by arcing contacts.
2) Operating and Release Times: 100 milliseconds or less.
3) Positive Locking: Without use of hooks, latches, and semi-permanent magnets.

S. Current Sensing Relays:
1. Output Characteristics: SPST solid state, normally open.
2. Output Rating: 60ma, 24 VDC minimum.
3. Trip Point: Adjustable.

T. Aquastats:
1. Features:
a. Switching: SPDT.
b. Contacts: Totally enclosed.
2. Setpoint:
a. Adjustment: External with visible scale.
b. Range: As appropriate for application.
3. Mountings:
a. Immersion Type: In separable well.

b. Surface Type: With adjustable pipe clamp.
4. Differential: 2ºF, fixed.

2.2 SENSORS

A. S01 – Wall Mounted Temperature Sensor with Display
1. Application: Rooms with adjustable temperatures.
2. Manufacturers:
a. Neptronic TUUB thermostat, black in color.
3. This device shall allow the user to set the space temperature.
4. This device shall be BACnet compatible.

B. S02 – Wall-Mounted Combination Temperature/Humidity Sensor:
1. Application: Packaged RTU's
2. Manufacturers:
a. Equipment Provider as specified in Division 23.
3. This device shall monitor Temperature and Humidity in one device.
4. This device shall have no local display or adjustment capability.

C. S03 – Wall-Mounted Temperature:
1. Application: Variable Air Volume (VAV) Boxes
2. Manufacturers:
a. Equipment Provider as specified in Division 23.
3. This device shall monitor Temperature in one device.
4. This device shall have no local display or adjustment capability.

D. S04 – Wall-Mounted Temperature:
1. Application: Variable Air Volume (VAV) Boxes
2. Manufacturers:
a. Equipment Provider as specified in Division 23.
3. This device shall monitor Temperature in one device.
4. This device shall have local display and adjustment capability.

E. S05 – Wall-Mounted Temperature:
1. Application: Variable Air Volume Diffusers
2. Manufacturers:
a. Equipment Provider as specified in Division 23.
3. This device shall monitor Temperature in one device.
4. This device shall have no local display or adjustment capability.

F. S06 – Wall-Mounted Combination Temperature/Humidity Sensor:
1. Application: Natatorium
2. Manufacturers:
a. MAMAC Part# PR-276-R10-VDC or equivalent as submitted and accepted.
3. This device shall monitor Temperature and Humidity in one device.
4. This device shall have no local display or adjustment capability.

G. S07 – Wall-Mounted Adjustable Temperature/Humidity Sensor:
1. Application: IDF/MDF
2. Manufacturers:
a. Equipment Provider as specified in Division 23.
3. This device shall monitor Temperature and Humidity in one device.
4. This device shall have local display and adjustment capability.

H. S08 – Wall-Mounted Temperature Sensor:
1. Application: IDF/MDF
2. Manufacturers:
   a. ACI Part # A/AN-R or equivalent as submitted and accepted.
3. This device shall enable the BAS to monitor temperature.
4. This device shall have no local display or adjustment capability.

I. S09 – Wall-Mounted Temperature Sensor:
1. Manufacturers:
   a. Luxpro #LV3 or equivalent as submitted and accepted.
      1) Equivalents installed without approved submittal shall be removed and replaced with basis of design.
2. This device shall be a line voltage, cooling only thermostat.

J. S10 – Duct-Mounted Temperature Sensor:
1. Application: Pool Unit
2. Manufacturers:
   a. Equipment Provider as specified in Division 23.

K. S11 – Duct-Mounted Temperature Sensor:
1. Application: General RTU's
2. Manufacturers:
   a. Equipment Provider as specified in Division 23.

L. S12 – Duct-Mounted Temperature Sensor:
1. Application: Hot Yoga reheat coil temp sensor
2. Manufacturers:
   a. Kele Part #ST-D24-XH
      1) Equivalents installed without approved submittal shall be removed and replaced with basis of design.

M. S13 – Duct-Mounted Pressure Sensor:
1. Manufacturers:
   a. Equipment Provider as specified in Division 23.

N. S14 – Duct-Mounted CO2 Sensor:
1. Manufacturers:
   a. Equipment Provider as specified in Division 23

O. S15 – Plenum-Mounted Pressure Sensor:
1. Manufacturers:
   a. MAMAC Part # PR-274-R2-VDC or equivalent as submitted and accepted.
      1) Equivalents installed without approved submittal shall be removed and replaced with basis of design.

P. S16 – Ceiling-Mounted Pressure Port:
1. Manufacturers:
   a. ACI Part # A/SP-PUP or equivalent as submitted and accepted.
      1) Equivalents installed without approved submittal shall be removed and replaced with basis of design.

Q. S17 – Pipe-Mounted Immersion Temperature Sensor:
1. Manufacturers:
   a. ACI Part #A/AN-IM_2.5-PB or equivalent as submitted and accepted.

1) Equivalents installed without approved submittal shall be removed and replaced with basis of design.

R. S18 – Pipe Mounted Immersion Temperature Sensor:
1. Manufacturers:
a. ACI Part # A/AN-IM-4-PB or equivalent as submitted and accepted.
1) Equivalents installed without approved submittal shall be removed and replaced with basis of design.

S. S19 – Secondary Loop Pipe-Mounted Immersion Temperature Sensor:
1. Manufactures:
a. Equipment Provider as specified in Division 23.

T. S20 – Outdoor Mounted Combination Temperature/Humidity Sensor:
1. Manufacturers:
a. ACI Part # A/RH2-AN-O or equivalent as submitted and accepted.
1) Equivalents installed without approved submittal shall be removed and replaced with basis of design.

U. S21 – Outdoor Mounted Pressure Port:
1. Manufacturers:
a. ACI Part # A/O-PUP-V or equivalent as submitted and accepted.
1) Equivalents installed without approved submittal shall be removed and replaced with basis of design.

V. S22 – Panel-Mounted High-Limit Controller:
1. Manufacturers:
a. ACI Tekmar SP150, NO EXCEPTIONS

W. S23 – Pipe-Mounted Flow Switch
1. Manufacturers:
a. Equipment Provider as specified in Division 13.

X. S24 – Wall-Mounted Timer with Display
1. Manufacturers:
a. Wattstopper Part #TS-400-24-B, or equivalent as submitted and accepted.
1) Equivalents installed without approved submittal shall be removed and replaced with basis of design.

2.3 EQUIPMENT SPECIFIC TERMINATIONS

A. All control wiring and terminations shall be per the equipment vendor's specifications. Installing contractor shall be responsible for thoroughly reviewing all installation guidelines and meeting equipment requirements.

PART 3 - EXECUTION

3.1 PREPARATION

A. Examine areas and conditions under which control systems are to be installed. Do not proceed with Work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

B. These specifications call out certain duties of the Contractor and any subcontractor. They are not intended as a material list of all items required by the Contract.

3.2 INSTALLATION

A. Device in-wall installation coordination requirements:
   1. No sensors shall be installed on feature walls.
   2. Do not mount behind Gym wall padding. Locate minimum of 6” above to of padding.
   3. Do not mount behind Studio wall mirrors. Create RFI to relocate.
   4. Do not mount behind wall wood paneling. Create RFI to relocate.
   5. Do not mount behind wall tile. Create RFI to relocate.
   6. Do not mount in exterior walls. If required, caulk all seams, including mud-ring to drywall.
   7. Provide additional insulation behind yoga studio boxes to avoid leakage from non-heated spaces affecting sensor readings.
   8. Do not mount inside CMU walls.
   9. Verify ADA compliance for Massage, Infants, Mother’s, and Group Fitness.
   10. Verify 60” above finished floor for all others except rooms with wall padding and Natatorium.
   11. Coordinate height and spacing requirements with division 26 installed devices. When mounting adjacent to other devices, match height and spacing.
   12. Space pressure sensing ports are mounted in ceiling tiles.
   13. Occupancy sensors are mounted in ceiling tiles.

B. Utilize licensed installers and comply with Division 26 electrical specifications.

C. Provide related items and work indicated on the DI drawings and items and work called for in this Division of the Specifications. This includes all incidentals, equipment, appliances, services, hoisting, scaffolding, supports, tools, supervision, labor, consumable items, fees, licenses, etc., necessary to provide complete systems. Perform start up, configuration, programming and commissioning coordination on each control product and system to provide fully operable systems in accordance with the specified functional performance.

D. Installation shall be in accordance with manufacturer’s published recommendations and shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

E. The DI drawings show the general arrangement of the respective systems. Follow these Drawings as closely as actual building construction and the work of other trades will permit. Provide devices, power, fittings, sensors, controllers, wiring and accessories, which may be required but are not shown on the Drawings or specified herein. The Contractor shall be responsible for achieving the sequence of operations and intent of the system design.

F. All installation shall be in accordance with manufacturer’s published recommendations.

G. Limit LAN cable lengths to no longer than 80% of the longest dimension published by the manufacturer of the cable between the most remote network nodes.

H. Comply with all rules, guidelines and procedures defined by the Owner’s IT authority.

END OF SECTION 25 2000

SECTION 25 9000

BUILDING AUTOMATION SYSTEM – SEQUENCE OF OPERATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes sequence of operations for whole facility automation, including subsystems and equipment.

1.2 1.02 RELATED DOCUMENTS

A. Section 23 09 34 - VARIABLE FREQUENCY DRIVES

B. Section 25 10 00 - BAS NETWORK SYSTEMS

C. Section 25 20 00 - BAS INSTRUMENTATION

D. Section 25 30 00 - BAS TERMINATIONS

1.3 REFERENCE STANDARDS

A. Refer to Section 25 10 00 - BAS NETWORK SYSTEMS.

1.4 DEFINITIONS

A. Refer to Section 25 10 00 - BAS NETWORK SYSTEMS.

1.5 SCOPE OF WORK

A. Refer to Section 25 10 00 - BAS NETWORK SYSTEMS.

PART 2 - SEQUENCES

2.1 HEATING WATER SYSTEM

A. Modulating-Cascading Boiler (B-1, B-2):
   1. The boilers internal burners shall be controlled by the factory installed Master Boiler Controller (MBC).
   2. The MBC shall energize and modulate the Master Boiler between 20% to 100% fire-rate to maintain the supply water temperature at setpoint (150°F).
   3. If the Master Boiler is unable to maintain the setpoint while firing at 95% for 10 minutes (adj.), the MBC shall energize and modulate the secondary boiler between 20% and 100% fire-rate to maintain the setpoint.
   4. This cascade shall continue for however many boilers are in the plant.

5. As demand decreases, the staging shall be reversed.
6. As boilers stage on/off the boiler isolation valve shall open and close.
7. As multiple boilers turn on, boilers shall match fire rate and modulate up/down together.

B. Boiler Loop Pump (P-1, P-2):
1. The lead pump will operate continuously.
2. If the lead pump fails to start or fails while running, the BAS shall switch to the lag pump and indicate an alarm on the BAS.
3. If the lead pump is not maintaining system differential pressure, then the lag pump shall turn on and both pumps shall turn on to 50% speed. These shall be modulated as required to maintain differential pressure setpoint.
4. If both pumps fail, the BAS shall alarm, and boiler shall turn off.
5. A system differential pressure sensor shall control the pump VFD to maintain system differential pressure at setpoint.
6. The BAS shall modulate the minimum flow bypass valve to maintain system pressure when boiler pump VFDs are at minimum speed.
7. The lead boiler pump shall rotate based on a run time of 200 hours (adj.).

C. Pool Heat Exchangers (HX-1, HX-2, HX-4)
1. Modulate heat exchanger control valve to maintain pool return water temperature at setpoint.
2. Flow Switch Safety: Wire switch back to control valve signal and open circuit when switch is open.

D. Warm Spa Heat Exchangers (HX-3)
1. Modulate heat exchanger control valve to maintain pool return water temperature at point.
2. High Limit Temperature Controller shall shunt control signal valve actuator.
3. Flow Switch Safety: Wire switch back to control valve signal and open circuit when switch is open.
4. Control valve shall be fail closed style. No exceptions.

2.2 MAKEUP AIR UNIT (MAU-1, EF-7) [KITCHEN]

A. The makeup air unit is enabled by the Hood Control Panel and interlocked with the hood exhaust fan.

B. The makeup air unit shall automatically shut down in conjunction with fire detection or manual activation of Ansul system. Necessary interlocks shall be provided per Code.

C. Outdoor Air Damper:
1. Upon enable call from the Hood Control Panel, the outdoor air damper shall open, then the fan shall energize. Reverse sequence on call to disable unit from the Hood Control Panel.

D. DX Cooling:
1. The mechanical cooling shall operate to maintain the discharge air temperature at 10°F (adj.) above of room temperature setpoint in cooling mode per energy code.
2. Lockout: The mechanical cooling shall be locked out when the outside air temperature is less than 75°F (adj.).

E. Heating:
1. The gas-fired heating shall operate to maintain the discharge air temperature at 10°F (adj.) below room temperature setpoint in heating mode per energy code.
2. Lockout: The heating shall be locked out when the outside air temperature is greater than 65°F (adj.).

2.3 VAV TERMINAL UNIT

A. Heating:
   1. On a call for heat from the space sensor, the VAV Box dampers shall modulate to the minimum heating position and open/energize the heating coil. On a continued call for heat, the air volume damper shall modulate to the maximum heating damper position and the reheat coil shall modulate to maintain set point.
   2. [ELECTRIC HEATING COIL] Factory furnished SCR controller and digital thermostat shall modulate electric heat to maintain space set point. [N.T.S - Ensure the manufacturer recommended minimum airflow is provided for the heating coil size. Typically this is 70 CFM/KW.]

B. Cooling:
   1. On a call for cooling from the space sensor, the electric reheat coil shall be disabled and air volume damper shall modulate between the minimum position to the maximum position in order to maintain the room set point. In cooling mode, the VAV box shall close to minimum position if the inlet air temperature is higher than the room temperature set point in order to not overheat the room.

2.4 HEAT PUMP UNIT

A. [N.T.S – LIFETIMES PREFERENCE IS TO UTILIZE MANUFACTURER PROVIDED CONTROLLERS AND JUST SENT SPACE SETPOINT. ALLOW THE UNITS TO CONTROL THEMSELVES AS NEEDED. SPACE SENSORS SHALL BE NON-ADJUSTABLE].

2.5 EXHAUST FAN - SCHEDULED (EF-1, EF-2, EF-3, EF-5, EF-6)

A. Upon activation of building occupied mode, the motorized damper shall open and make contact with the end switch, and the fan shall energize.

B. Upon activation of building unoccupied mode, the fan shall deenergize and motorized damper shall close.

C. Fan shall operate constant volume.

D. If the fan fails, an alarm shall initiate at the building automation system.

E. In the event of a BAS failure the fan shall be configured to run continuously.

2.6 EXHAUST FAN – CONTINUOUS OPERATION (EF-4, EF-8, EF-9)

A. Fan shall operate constant volume.

B. If the fan fails, an alarm shall initiate at the building automation system.

2.7 TRANSFER FAN (TF-1, TF-2)

A. Fan shall enable/disable from the building automation system.

B. Provide BAS space thermostat to start fan when the space temperature reaches 80°F (adj.).

C. When BAS space thermostat reaches 78°F (adj.) the fan shall turn off.

D. In the event of a BAS failure the fan shall be configured to run continuously.

2.8 TRANSFER FAN WITH REHEAT COIL (TF-1, EDC-2)

A. Upon activation of building occupied mode, the fan shall energize.

B. Pool HVAC space sensor shall provide input to the building automation system to control the duct mounted heating coil.

C. The duct mounted heating coil shall open/energize and modulate to maintain a discharge air temperature of 90°F (adj.).

2.9 COLD SPA (CH-1, PC-1 & PC-2)

A. The cold spa supply water temperature shall have a setpoint of 50°F (adj.) locally from the cold plunge controller.

B. The cold spa manufacturer provided controller shall modulate the condensing unit as required to maintain water temperature. When supply water temperature is satisfied the condensing unit shall turn off.

C. Building automation system shall monitor cold spa supply and return water temperatures via thermowells.

2.10 SINGLE ZONE - ROOFTOP PACKAGE UNIT (RTU-5, RTU-6, RTU-8, RTU-9, RTU-10))

A. Occupied Mode:
   1. The Supply Fan, Exhaust Fan, DX Cooling, Gas Heating, Economizer, Dehumidification, and Demand Controlled Ventilation: shall be enabled and operate per defined sequences below.

B. Unoccupied Mode:
   1. The Supply Fan, Exhaust Fan, DX Cooling, Gas Heating, Economizer, Dehumidification, and Demand Controlled Ventilation: shall be disabled.

C. Supply Fan:
   1. The Supply Fan shall be commanded to run at a constant speed.

D. Exhaust Fan:
   1. The Exhaust Fan shall be commanded to run when the Outside Air Damper position is greater than 50% open.

E. DX Cooling:
   1. The mechanical cooling shall stage compressors to maintain the space temperature at the Zone Cooling Setpoint.
   2. Lockout: The mechanical cooling shall be locked out when the outside air temperature is less than 45.0 °F (adj).

F. Heating:

1. The gas-fired heating shall stage burners to maintain the space temperature at the Zone Heating Setpoint.
2. Lockout: The heating shall be locked out when the outside air temperature is greater than 45.0 °F (adj).

G. Economizer:
1. 1. The Economizer shall be active when the outdoor enthalpy is below the ODE Setpoint and there is a cooling demand. The Economizer shall modulate the outside air damper and return air damper to maintain the supply air temperature.
2. 2. When not active, the Economizer shall modulate the outside air damper to the minimum position.

H. Dehumidification:
1. The Dehumidification shall be active when the Space Relative Humidity is greater than the Zone RH Setpoint. The compressors and hot-gas reheat shall be modulated to maintain supply air temperature.

I. Demand Control Ventilation (DCV):
1. The DCV shall modulate the outside air and return air dampers from minimum position to maximum position based on space carbon dioxide concentration.

2.11 MSAV - ROOFTOP PACKAGE UNIT (RTU-3,RTU-4, RTU-7, RTU-11, RTU-12, RTU-13, RTU-14, RTU-15)

A. Occupied Mode:
1. The Supply Fan, Exhaust Fan, DX Cooling, Gas Heating, Economizer, Dehumidification, and Demand Controlled Ventilation: shall be enabled and operate per defined sequences below.

B. Unoccupied Mode:
1. The Supply Fan, Exhaust Fan, DX Cooling, Gas Heating, Economizer, Dehumidification, and Demand Controlled Ventilation: shall be disabled.

C. Supply Fan:
1. The Supply Fan speed shall be fixed to the required percentage of maximum setpoint for each of the following modes;
   a. DX Cooling Stage #1
   b. DX Cooling Stage #2
   c. DX Cooling Stage #3
   d. DX Cooling Stage #4
   e. Gas Heating Mode
   f. Ventilation Mode

D. Exhaust Fan:
1. The Exhaust Fan shall be commanded to run when the Outside Air Damper position is greater than 50% open.

E. DX Cooling:
1. The mechanical cooling shall stage compressors to maintain the space temperature at the Zone Cooling Setpoint.
2. Lockout: The mechanical cooling shall be locked out when the outside air temperature is less than 45.0 °F (adj).

F. Heating:

1. The gas-fired heating shall stage burners to maintain the space temperature at the Zone Heating Setpoint.
2. Lockout: The heating shall be locked out when the outside air temperature is greater than 45.0 °F (adj).

G. Economizer:
1. Outdoor air temperature, humidity and enthalpy shall be transmitted via NOAA to the building automation system which will input outside conditions to each unit.
2. The Economizer shall be active when the outdoor enthalpy is below the ODE Setpoint and there is a cooling demand. The Economizer shall modulate the outside air damper and return air damper to maintain the supply air temperature.
3. When not active, the Economizer shall modulate outside air damper the minimum position.

H. Dehumidification:
1. The Dehumidification shall be active when the Space Relative Humidity is greater than the Zone RH Setpoint. The compressors and hot-gas reheat shall be modulated to maintain supply air temperature.

I. Demand Control Ventilation (DCV):
1. The DCV shall modulate the outside air and return air dampers from minimum position to maximum position based on space carbon dioxide concentration.

2.12 VARIABLE AIR VOLUME - ROOFTOP PACKAGED UNIT (RTU-1,RTU-2)

A. Occupied Mode:
1. The Supply Fan, Exhaust Fan, DX Cooling, Gas Heating, Economizer, Dehumidification, and Demand Controlled Ventilation: shall be enabled and operate per defined sequences below.

B. Unoccupied Mode:
1. The Supply Fan, Exhaust Fan, DX Cooling, Gas Heating, Economizer, Dehumidification, and Demand Controlled Ventilation: shall be disabled.

C. Supply Fan:
1. The Supply Fan shall modulate to maintain the supply air static pressure at the Supply Air Static Pressure Setpoint.
2. Setpoint Reset:
   a. The BAS shall monitor damper position of all VAV terminal units.
   b. The initial duct static pressure setpoint shall be 1.00” w.c. (adj.) or the setpoint determined during test and balance to achieve VAV airflows.
   c. When all zone dampers are throttling closed, below 85% open, the duct static pressure setpoint shall be incrementally reset down by 0.1” w.c. (adj.) at a frequency of 15 minutes to the minimum setting of 0.5” w.c. (adj.).
   d. If more than 3 VAV terminal units (adj.) are at 100% open the reset sequence shall reverse and incrementally add 0.1” w.c. (adj.) every 15 minutes until the initial setpoint is reached.

D. Relief Fan:
1. The Return Fan shall be commanded to run when the Outside Air Damper position is greater than 50% open.

E. DX Cooling:
1. The mechanical cooling shall stage compressors to maintain the supply air temperature at the Supply Air Temperature Setpoint.

2. Setpoint Reset:
    a. The BAS shall monitor cooling demand of all VAV terminal units.
    b. The DAT setpoint shall initially be 55°F (adj.).
    c. When the cooling demand of 100% of zones (adj.) is satisfied, the DAT setpoint shall be incrementally reset up by 1°F (adj.) at a frequency of 15 minutes to the maximum setting of 65°F (adj.).
    d. When 3 VAV terminal units (adj.) are above 90% damper position then the reset sequence shall reverse and incrementally subtract 1°F (adj.) every 15 minutes until the DAT reaches 55°F (adj.).
3. Lockout: The mechanical cooling shall be locked out when the outside air temperature is less than 45.0°F (adj).

F. Heating:
1. The gas-fired heating shall stage burners to maintain the supply air temperature at the Supply Air Temperature Setpoint.
2. Setpoint Reset: the setpoint shall be reset based on the sequence above.
3. Lockout: The heating shall be locked out when the outside air temperature is greater than 55.0 °F (adj).

G. Economizer:
1. Outdoor air temperature, humidity and enthalpy shall be transmitted via NOAA to the building automation system which will input outside conditions to each unit.
2. The Economizer shall be active when the outdoor enthalpy is below the ODE Setpoint and there is a cooling demand. The Economizer shall modulate the outside air damper and return air damper to maintain the mixed air temperature at the Mixed Air Temperature Setpoint (adj).
3. When not active, the Economizer shall modulate the outside air damper to the minimum position.

H. Dehumidification:
1. The Dehumidification shall be active when the Space Relative Humidity is greater than the Zone RH Setpoint. The compressors shall be modulated to maintain supply air temperature at the Supply Air Temperature Setpoint.
2. The Supply Air Temperature Setpoint shall be overridden to a value of two (2) °F below the current return air dew point. The override shall be released when the mode is not active.

I. Demand Control Ventilation (DCV):
1. The DCV shall modulate the outside air and return air dampers from minimum position to maximum position based on space carbon dioxide concentration.
2. Setpoint Reset: the setpoint shall be reset based on the sequence above.

2.13 ENERGY RECOVERY UNIT – FITNESS FLOOR (ERU-2)

A. Unoccupied Mode:
1. Outside air heat exchanger face and bypass damper actuators are de-energized, both dampers spring return closed.
2. Supply de-energized. Outside air damper closes.
3. Exhaust fan ramps down to 30% (adj.) fan speed to maintain exhaust out of the locker rooms and wet suite.

B. Occupied Mode:
1. Outside air heat exchanger face and bypass damper actuators are powered.
2. Controller checks damper end switch status.
3. Exhaust fan starts after dampers are open as proven by end switches.
4. Supply fan starts 15 sec (adj.) after the exhaust fan.

5. Heating, cooling, and face & bypass operation per below.

C. Supply Fan:
   1. The supply fan VFD shall be used to balance the supply fan. Once the supply fan is balanced the supply fans shall run constant speed during occupied hours.

D. Exhaust Fan:
   1. The exhaust fan VFD shall modulate to maintain the differential pressure between the Locker Rooms and the adjacent hallway. The pressure setpoint shall be (-) 0.030” w.c.

E. Economizer:
   1. The economizer (energy recovery reduction type) and the direct expansion coil are controlled to maintain the supply temperature set point. The economizer, if available, will be used as the first stage of cooling.
      a. Outside air temperature < space air temperature -2°F:
         1) The outside air heat exchanger face/bypass dampers modulate (bypassing outside air around the heat exchanger) to maintain supply temperature set point.
      b. Outside air temperature > space air temperature:
         1) Heat exchanger face/bypass dampers are in full face position (all air through heat exchanger).
   2. RTU Economizer Mode: Upon a signal from the BAS that the fitness floor RTU’s are in economizer mode, the ERU supply fan shall turn off. Exhaust fan shall maintain operation. (N.T.S - When fitness floor RTU’s are economizing the ERU’s ventilation air is no longer needed.)
   3. Energy Recovery: When defrost and economizer functions are inactive, the outside air heat exchanger face damper will be full open and outside air heat exchanger bypass damper will be full closed. All outside air passes through the heat exchanger.
   4. When the unit is de-energized both dampers (face & bypass) close, to shut off outside air when the unit is de-energized.

F. Defrost:
   1. The outside air heat exchanger face & bypass dampers modulate (bypassing outside air around the heat exchanger) to maintain the exhaust air temperature above freezing (setpoint = 34 °F).

G. Dehumidification:
   1. Occupied dehumidification mode is only active if outside air dew point > 55°F (adj.)
   2. Dehumidification mode control:
      a. Cooling is controlled to maintain the direct expansion coil leaving air temperature set point: 55°F (adj.).
      b. Hot gas reheat is controlled to maintain the supply temperature set point (heating mode).

H. Cooling: [NTS: INTENTION IS TO PROVIDE ROOM NEUTRAL AIR UNTIL WE NEED TO DEHUMIDIFY THEN WE USE THE DEHUMIDIFICATION FUNCTION]
   1. Temperature Control: The compressors are activated to maintain the discharge air temperature setpoint (see setpoints below).
      a. Space temperature set point heating mode: 70°F (adj.)
      b. Space temperature set point cooling mode: 75°F (adj.)
   2. Lockout: The mechanical cooling shall be locked out when the outside air temperature is less than 50°F.

I. Heating:
   1. Heat: The heating shall be modulated to maintain the supply temperature setpoint.

2. Lockout: the heating will be locked out when the outside air temperature is greater than 50°F.

J. Refrigeration Management Safety Control:
1. Upon detection of a refrigerant leak, the unit shall execute the following safety measures:
   a. Fan(s) enabled
   b. Compressor(s) disabled
   c. Ignition source(s) disabled
   d. Activate an alarm, available to the building, if additional safety measure(s) are required.

K. Non-Shutdown Safeties
1. Dirty Filter Switches
   a. If the filter differential pressure rises above the adjustable set point of the switch, the differential pressure switch shall signal the unit controller to activate an alarm.

L. Unit Shutdown Safeties
1. Supply Temperature Low Limit
   a. If the unit supply temperature drops below 35°F (adj.), the unit controller shall shut down the unit after an adjustable time delay.
2. Supply Temperature High Limit
   a. If the unit supply temperature rises above 120°F (adj.), the unit controller shall shut down the unit after an adjustable time delay.
3. Phase/Voltage Monitor
   a. A phase/voltage protection relay shall be provided for each unit. Upon sensing a loss of phase or voltage, the unit shall immediately shut down.
4. DX Condensate Drain Pan Overflow Switch
   a. In the case of an overfull drain pan, the switch shall signal the unit controller to activate an alarm and shut down the unit.
5. Smoke Detector(s)
   a. Return and/or supply smoke detector(s), provided, installed and field wired in series, by others. Upon detecting smoke, the smoke detector(s) shall send a binary signal to the unit controller to immediately shut down the unit.
6. High Limit Duct Static Pressure Switch
   a. If supply duct static pressure rises above the switch set point (3” W.C., adj.), the differential pressure switch shall signal the unit controller to immediately shut down the unit.

2.14 ENERGY RECOVERY UNIT – POOL (ERU-1)

A. Unoccupied Mode:
1. Outside air heat exchanger face and bypass damper actuators are powered.
2. Controller checks damper end switch status.
3. Exhaust fan shall be enabled and set to 50% balanced fan speed after dampers are open as proven by end switches.
4. Supply fan shall be enabled and set to 50% balanced fan speed 15 seconds (adj.) after exhaust fan starts.
5. Dehumidification, economizer, face and bypass damper, cooling and heating are enabled and operate per sequence below.
6. Heating enables when the return temperature drops below the unoccupied setpoint, 80°F (adj.), to increase return temperature. Heating will be disabled when the return temperature reaches the unoccupied setpoint + a 5°F differential (adj.).

B. Occupied Mode:
1. Outside air heat exchanger face and bypass damper actuators are powered.

2. Controller checks damper end switch status.
3. Exhaust fan ramps to occupied speed.
4. Supply ramps to occupied speed 15 sec (adj.) after the exhaust fan.
5. Dehumidification remains enabled.
6. Heating, cooling, and face & bypass operation per below.

C. Supply Fan:
1. The supply fan VFD shall be used to balance the supply fans to the CFM listed on plans. Once the supply fan is balanced to design airflow the supply fan shall maintain constant airflow during operating hours.
2. During occupied hours the supply fan speed shall drop to 50% max speed.

D. Exhaust Fan:
1. The exhaust fan VFD shall modulate to maintain the differential pressure between the indoor pool and the locker rooms. The pressure setpoint shall be (-) 0.040” w.c. (adj.)
2. During unoccupied hours the exhaust fan shall continue to control to the occupied mode pressure differential.

E. Outside Air Damper:
1. The unit outside airflow monitoring damper will maintain minimum and maximum outdoor airflow limits as shown on the plans.

F. Refrigeration Management Safety Control:
1. Upon detection of a refrigerant leak, the unit shall execute the following safety measures:
   a. Fan(s) enabled
   b. Compressor(s) disabled
   c. Ignition source(s) disabled
   d. Activate an alarm, available to the building, if additional safety measure(s) are required.

G. Heating:
1. The heating source is controlled to maintain the space temperature set point (adj.)
2. The unit outside air damper shall modulate to maintain the minimum airflow set point in heating mode.
3. There is no unoccupied mode heating set point. Occupied space temp setpoint shall remain 24/7.

H. Cooling:
1. Temperature Control: The compressors are activated to maintain the discharge air temperature setpoint (see setpoints below). The leaving air temperature is automatically reset up/down (between 80 °F and 85 °F) to maintain the room relative humidity setpoint (60% RH).
   a. Stage 1: Economizer (energy reduction type) active only if the outside air temperature < return air temperature.
      1) The heat exchanger outside air face/bypass damper modulate (bypassing outside air around the heat exchanger) to maintain the space temperature set point.
   b. Stage 2: Mechanical Cooling
      1) The cooling coil is controlled to maintain the space supply temperature set point. The outside air damper will maintain the maximum airflow set point, while the direct expansion coil is energized.
      2) The heat exchanger outside air face/bypass damper is open to face at its maximum position.
2. Lockout: The mechanical cooling shall be locked out when the outside air temperature is less than 50 °F.

I. Dehumidification:
   1. Stage 1
      a. Outside air damper modulates, between its minimum and maximum airflow limits, to maintain the space humidity set point.
      b. The heat exchanger outside air face & bypass damper is open to face at its maximum open position.
      c. If heating is active and unable to maintain the unit supply temperature set point, the dehumidification damper control loop shall be limited to its minimum position.
   2. Stage 2
      a. The unit outside air damper to maintain the maximum airflow set point.
      b. The cooling coil is energized for space relative humidity control.
      c. The heat exchanger outside air face/bypass damper is open to face at its maximum open position.
      d. The mechanical cooling is controlled to maintain the cooling coil leaving air temperature set point, which is reset up and down between the values listed below, to maintain the space humidity set point below:
         1) Dehumidification coil leaving minimum set point 55°F (adj.)
         2) Dehumidification coil leaving maximum set point 65°F (adj.)

J. Defrost:
   1. The outside air heat exchanger face & bypass dampers modulate (bypassing outside air around the heat exchanger) to maintain the exhaust air temperature above freezing (setpoint = 38 °F).

K. Non-Shutdown Safeties
   1. Dirty Filter Switches
      a. If the filter differential pressure rises above the adjustable set point of the switch, the differential pressure switch shall signal the unit controller to activate an alarm.

L. Unit Shutdown Safeties
   1. Supply Temperature Low Limit
      a. If the unit supply temperature drops below 35°F (adj.), the unit controller shall shut down the unit after an adjustable time delay.
   2. Supply Temperature High Limit
      a. If the unit supply temperature rises above 120°F (adj.), the unit controller shall shut down the unit after an adjustable time delay.
   3. Phase/Voltage Monitor
      a. A phase/voltage protection relay shall be provided for each unit. Upon sensing a loss of phase or voltage, the unit shall immediately shut down.
   4. DX Condensate Drain Pan Overflow Switch
      a. In the case of an overfull drain pan, the switch shall signal the unit controller to activate an alarm and shut down the unit.
   5. Smoke Detector(s)
      a. Return and/or supply smoke detector(s), provided, installed and field wired in series, by others. Upon detecting smoke, the smoke detector(s) shall send a binary signal to the unit controller to immediately shut down the unit.
   6. High Limit Duct Static Pressure Switch
      a. If supply duct static pressure rises above the switch set point (3” W.C., adj.), the differential pressure switch shall signal the unit controller to immediately shut down the unit.

2.15 YOGA STUDIO (RTU-9, EDC-1)

A. YOGA STUDIO MONITORING:

1. The BAS shall monitor the Studio temperature, humidity, radiant panel status and carbon dioxide concentration.
2. The Space Temperature Setpoint shall be adjustable from the local adjustable thermostat.
3. The setpoint shall be adjustable at 1 °F intervals.
4. The Heating Setpoint shall be equal to the Space Temperature Setpoint.
5. The Cooling Setpoint shall be equal to the Heating Setpoint plus the Cooling Offset.
6. The Cooling Offset shall be set to 4 °F.
7. The CO2 Setpoint shall be set to 1500 ppm.

B. VENTILATION MODE:
1. The Ventilation Mode shall be 50% of the design airflow rate.
2. The Ventilation Mode is active only when the RTU is not heating or cooling.

C. RTU ECONOMIZER MODE:
1. The Economoizer shall be active when the outdoor enthalpy is below the ODE Setpoint and there is a cooling demand. The Economizer shall modulate the outside air damper and return air damper to maintain supply air temperature.
2. When not active, the Economizer shall modulate the outside air damper to minimum position per the RTU schedule.

D. UNNOCUPIED MODE:
1. The Space Temperature setpoint shall reset to 78°F in Cooling Mode and 64°F in heating mode.
2. The RTU Economizer, DX Cooling, gas heating and DCV shall be enabled to maintain the studio at setpoint.

E. OCCUPIED MODE:
1. The Space Temperature shall be controlled to 75°F in Cooling Mode and 72°F in Heating Mode until local setpoint adjustment.
2. The RTU Economizer, DX cooling, gas heating and DCV shall be enabled to maintain the Studio at setpoint.
3. The radiant heat panels shall be activated with local adjustable 90-minute timer (Hot Yoga only).

F. HEATING COIL CONTROL:
1. The reheat coil (hydronic or electric) shall modulate when space temperature is above 80°F to maintain the duct discharge air temperature at the room space temperature setpoint.

2.16 EQUIPMENT SCHEDULING/SETPOINTS

A. Hours of Operation:
1. The schedules below are Life Time standard naming and hours of operation. If a club has non-standard spaces then the “custom” rows should be used for these schedules. All non-standard schedule groups should be reviewed and approved by Life Time Property Development and Operations.

Schedule #	Type	Schedule Name	Area Served	Hours of Operation	Schedule Basis
1	Standard	Main Building	Gym, Cardio, Locker Rooms, Alpha	4am-Midnight	Hours of Operation
2	Standard	Pool	Natatorium	4am-Midnight	Hours of Operation
3	Standard	Office	Office/Work	5am-10pm	Hours of Operation
4	Standard	Tennis	Tennis	4am-Midnight	Hours of Operation
5	Standard	Café	Life Café	5am-10pm	Hours of Operation
6	Standard	Salon	Life Spa	5am-10pm	Hours of Operation
7	Standard	Child Care	Kids Academy	5am-10pm	Hours of Operation & Exerp
8	Standard	Mechanical	Mechanical and Laundry Room	4am-10pm	Hours of Operation
9	Standard	Studio 1	Studio 1	5am-10pm	Hours of Operation & Exerp
10	Standard	Studio 2	Studio 2	5am-10pm	Hours of Operation & Exerp
11	Standard	Studio 3	Studio 3	5am-10pm	Hours of Operation & Exerp
12	Standard	Cycle	Cycle Studio	5am-10pm	Hours of Operation & Exerp
13	Standard	Pilates	Pilates Studio	5am-10pm	Hours of Operation & Exerp
14	Standard	Yoga 1	Yoga Studio 1	5am-10pm	Hours of Operation & Exerp
15	Standard	Yoga 2	Yoga Studio 2	5am-10pm	Hours of Operation & Exerp
16	Standard	Barre	Barre	5am-10pm	Hours of Operation & Exerp
17	Standard	Clinic	Clinic	5am-10pm	Hours of Operation
18	Standard	Ed Center	Ed Center	5am-10pm	Hours of Operation

B. Temperature Setpoint Groups

1. The setpoints below are Life Time standard. If a club has non-standard spaces, then the “custom” rows should be used for these setpoints. All non-standard setpoint groups should be reviewed and approved by Life Time Property Development and Operations.

Temperature Setpoint Group #	Temperature Setpoint Group Name	Applicable Spaces	Occupied Cooling Setpoint (ºF)	Occupied Heating Setpoint (ºF)	Unoccupied Cooling Setpoint (ºF)	Unoccupied Heating Setpoint (ºF)	Relative Humidity Setpoint (%)
1	General	Locker Room Café/Bar Offices Kids Academy Laundry	72	69	77	64	60
2	Fitness Floor	Cardio, Weights Alpha GTX PT Desk Group Fitness #1	71	68	76	64	60
3	Mechanical Rooms	Mechanical Rooms	78	64	78	64	60
4	Barre	Barre Studio	75	72	78	64	60
5	Group Fitness #1	Group Fitness #1	71	68	76	64	55 (If hardwood)
6	Group Fitness #2	Group Fitness #2	71 (Adjustable Thermostat)	68 (Adjustable Thermostat)	78	64	55 (If hardwood)
7	Yoga	Yoga 1 Yoga 2	Adjustable Thermostat	Adjustable Thermostat	78	64	60
8	Cycle	Cycle	69	66	74	61	60

PART 3 - EXECUTION

3.1 Refer to Section 25 10 00 - IAS NETWORK SYSTEMS.

A. This Section includes control equipment and components for a complete Building Automation System (BAS), including control components for terminal heating and cooling units not supplied with factory-wired controls as well as integration of factory-wired controls.

B. Materials covered by this Section are to be purchased direct from the supplier unless noted otherwise. This contractor shall review and adjust shop drawings as necessary, coordinate shipping dates, receive products on the job site, store the product until installation and shall install the product as if it had been purchased by the contractor.

END OF SECTION 25 9000

SECTION 26 0100

GENERAL ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 WORK INCLUDED:

A. Provide all items, articles, materials, equipment, operations and/or methods listed, mentioned, shown and/or scheduled on the drawings and/or in these specifications, including all labor, services, permits, fees, utility charges, and incidentals necessary and required to perform and complete the electrical work described in this Division. Apply for all permits early in the project to avoid problems due to code revisions.

B. See the contract conditions (general and supplementary) and Division 1 for requirements concerning this Division including, but not limited to, submittals, shop drawings, substitution requests, change orders, maintenance manuals, record drawings, coordination, permits, record documents and guarantees.

1.3 RELATED WORK SPECIFIED ELSEWHERE:

A. Mechanical equipment motors to be furnished under another Division but connected under this Division. Starters shall be provided by this Division, unless otherwise noted on the electrical drawings. Verify and coordinate all equipment locations and electrical characteristics with other trades involved in the work. Coordination shall be done prior to rough-in or ordering equipment.

B. Control wiring for mechanical equipment beyond provisions shown on the Electrical Drawings shall be performed under another Division of the work.

1.4 COORDINATION:

A. Contractor agrees that any discrepancies between the contract drawings and the contract specifications are found the higher cost option shall be used for bidding purposes and the discrepancy brought to the attention of the Engineer for clarification.

B. Coordinate electrical connections to equipment:

1. Refer to equipment manufacturer's shop drawings and written instructions. Provide all power and control wiring with associated raceways for complete operation.

2. Where equipment is furnished with a cord and plug, provide receptacle to match equipment plug.

3. Verify electrical requirements of equipment on nameplate and installation manual. Ensure that the electrical connections meet the requirements and notify Architect/Engineer of any discrepancies.

4. Meet with equipment manufacturers’ representatives to coordinate equipment installation and electrical connections.

1.5 QUALITY ASSURANCE:

A. Do all work in accordance with regulations of serving electric utility, telephone utility, cable TV utility, National Electrical Code, state and local codes and amendments, National Fire Codes, and all other applicable codes.

1.6 PROJECT CONDITIONS:

A. The Contractor shall inspect the job site prior to bidding and familiarize himself with existing conditions which will affect the work. Prior to start of work, obtain "As built", "Record", or other Drawings showing existing underground utilities.

B. Electrical drawings are diagrammatic indicating approximate location of outlets, lighting fixtures, electrical equipment, etc. Consult the Architectural, Structural, and Mechanical Drawings to avoid conflicts with equipment, structural members, etc. When required make all deviations from Drawings to make the work conform to the building as constructed, and to related work of others. Minor relocations ordered prior to installation may be made without added cost to Owner.

C. The drawings are to scale as noted but the contractor shall refer to architectural and structural drawings for exact location of partitions, walls, beams, shafts, equipment, etc. Prior to rough-in, the contractor shall verify with Architect/Engineer exact location of all electrical devices, lights, poles, etc.

D. Call to the attention of the Architect any error, omission, conflict or discrepancy in Drawings and/or Specifications. Do not proceed with any questionable items of work until clarification of same has been made.

E. Under no conditions are beams, girders, footings or columns to be cut for electrical items unless so shown on Drawings or written approval obtained from the Architect.

F. Verify the physical dimensions of each item of electrical equipment to fit the available space and promptly notify the Architect prior to roughing-in if conflicts appear. Coordination of equipment to the available space and to the access routes through the construction shall be the Contractor's responsibility.

1.7 SUBMITTALS AND SHOP DRAWINGS:

A. In addition to Section 13300, “Submittal Procedures”, comply with the following.

B. Prior to ordering materials and equipment, the Contractor shall provide submittals in original, searchable PDF format, bookmarked with Section#, Product Name, ID tag, etc. Scanned pages will not be acceptable. Materials and equipment of each specification section shall be complete prior to submittal. Partial submittals will be marked “Incomplete” and returned for resubmittal.

C. List shall bear Contractor’s stamp, signature or other means to show that he has inspected same and certified that submitted material is correct in regard to quantity, size, dimension, quality and is coordinated with the Contract Documents.

D. See individual sections within this Division for products requiring submittal.

E. Each shop drawing submittal shall be prepared by the manufacturer, and shall clearly show manufacturer's name, catalog numbers, pictures, details, layout, type, size, rating, style, and all options identified in a permanent fashion. Specific items or options shall be permanently marked on sheets containing more than one option – do not rely on the Engineer to mark options.

F. Large equipment drawings such as UPS systems, generators, transformers, switchboards, and similar large equipment shall include the size, weight, seismic rating, emissions data, elevation, and wiring diagrams in addition to the product data.

G. Some sections of this Division may require shop drawings prepared on full size floor plans in AutoCAD or other CAD software. Where required, contact the Architect for the latest version of the floorplans and match the size and scale of the construction drawings. Drawings delivered to the contractor from the Architect/Engineer may not include addenda changes. Contractor shall only use floor plans for purposes of the construction on this job, and not for any other use or reuse. Add any required addenda items prior to finishing submittals.

H. Provide complete materials (all materials) list at the beginning of each tabbed section showing "Specification Section", "Material Item", "Manufacturer's Name and Catalog Number", and all pertinent data.

I. Provide samples where required in individual sections of this Division.

J. Contractor agrees that Shop Drawing Submittals processed by the Architect are not Change Orders; that the purpose of Shop Drawing Submittals by the Contractor is to demonstrate to the Architect that the Contractor understands the design concept, that he demonstrates his understanding by indicating which equipment and material he intends to furnish and install and by detailing the fabrication and installation methods he intends to use.

K. Contractor further agrees that if deviations, discrepancies or conflicts between Shop Drawings and Specifications are discovered either prior to or after Shop Drawing Submittals are processed by the Architect, the design Drawings and Specifications shall control and shall be followed.

L. Delays caused by contractor's neglect to submit on materials and equipment in time for Architect/Engineer's review, correction, resubmittal(s), shipment and delivery to the jobsite shall be the responsibility of the contractor.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. All materials shall be new and bear manufacturer's name, model number, electrical characteristics and other identification. All equipment to be U.L. approved or listed by another testing agency approved by authorities having jurisdiction.

B. Material and equipment shall be standard product of manufacturer regularly engaged in production of similar material for at least five years (unless specifically exempted) and shall be manufacturer's latest design.

C. If the description of a product is in conflict with the product as specified in the catalog number, the description shall generally take precedence. Contact the Architect for clarification if this occurs.

D. All equipment shall be rated and certified for the appropriate seismic design category or seismic use group for the installed location.

E. Provide access doors where required to maintain code-required access, or maintenance access, to equipment and wiring methods. Comply with Architectural division on Access Doors for requirements.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION METHODS:

A. All items, articles, materials, and equipment specified under this Division shall be installed per the manufacturer’s installation instructions. Where the manufacturer’s instructions are in conflict with the directions provided elsewhere in this Contract, the Engineer shall be notified prior to beginning rough-in.

B. Cutting or notching shall be kept to an absolute minimum and done when, and in a method approved by the Architect. Patch and correct finished surfaces damaged by electrical work.

C. Relays, panels, cabinets and equipment shall be level and plumb and installed parallel with structural building lines. All equipment and enclosures shall fit neatly without gaps, openings, or distortions. Provide approved devices for closing all unused openings.

D. Arrange circuit wiring as shown on the Drawings and do not alter or combine runs or homeruns without the specific approval of the Architect. Feeder runs shall not be recombined or altered.

E. Contactors, transformers, starters and similar noise producing devices shall not be placed on walls which are common to occupied space.

F. Ballasts, contactors, starters, transformers and like equipment which are found to be noticeably noisier than other similar equipment on the project will be deemed defective and shall be replaced.

G. In general, the mounting heights shall be as noted on the Drawings, however, the Architectural Interior Elevations and drawing notes taking precedence. Where no heights are indicated, request clarification from the Architect. Consult the Architectural, Mechanical and Structural drawings to avoid conflicts prior to roughing-in and for exact locations.

H. Where raceways penetrate floors, ceilings, ducts, chases, and fire walls, provide fire stopping to maintain integrity of the fire assembly. Firestopping method shall be approved by the Architect and Code Authority having jurisdiction.

I. Maintain the following minimum separations from voice and data cables. Power conduit - 12", transformers and motors - 40", fluorescent lighting - 12". Coordinate with the voice and data installer to assure these separations are met.

J. All ground and floor mounted equipment shall be installed and anchored to concrete structural or housekeeping pads.

3.3 SAFETY:

A. The Engineer has not been retained or compensated to provide design and construction review services relating to the Contractor's safety precautions or to means, methods, techniques, sequences or procedures required for the contractor to perform the work.

3.4 EQUIPMENT CONNECTIONS:

A. The location and method for connecting to each item of equipment shall be verified prior to roughing-in. The voltage and phase of each item of equipment shall be checked before connecting. Motor rotations shall be made in the proper direction. Pump motors are not to be test run until liquid is in the system and proper lubrication to all bearings in unit is checked.

B. Conduit, wire and circuit breaker sizes for mechanical, elevator and similar equipment are based on the equipment ratings of one manufacturer. The equipment actually furnished may have entirely different electrical characteristics. Conduit, wire, circuit breakers, disconnects, etc. shall not be ordered or installed until exact electrical requirements are obtained. Responsibility for this coordination rests with the Contractor.

3.5 ACCESS DOORS:

A. Provide access doors to maintain access to equipment, junction boxes, cable trays, open wiring systems and other equipment requiring access. Install access doors in locations approved by the Architect. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."

3.6 PAINTING:

A. All electrical equipment and conduit exposed in finished areas and on exterior walls are to be painted in color according to Architect’s instructions.

B. Contractor shall coordinate the timing of painting requirements.

C. Refer to Architectural specifications for methods and materials.

3.7 PROJECT RECORD DOCUMENTS:

A. Maintenance of Documents:

1. Maintain at Jobsite, One Record Copy of: Contract Drawings, Specifications, Addenda, Reviewed Shop Drawings, Change Orders, Other Modifications to Contract and Field Test Records.

2. Keep apart from documents used for construction.

3. Keep documents available at all times for inspection by Architect.

B. Recording:

1. Label each document "PROJECT RECORD."

2. Keep record documents current. Do not permanently conceal any work until required information has been recorded.

3. Contract Drawings, legibly mark to record actual construction; including but not limited to the following:

a. Depths of various elements; locations of underground items, with dimensions to building walls and corners; changes of dimensions and details; changes made by Addendum, Field Orders or Change Order.

b. Specifications and Addenda; legibly mark each Section to record changes made by Addendum, Field Order or Change Order.

C. As-Built Submittals:

1. At completion of project, transfer changes, addenda items, variations from drawings, exact routes of all feeders and service conduits, and locations of stubbed conduits to clean new prints and specifications which will be supplied by the Architect and deliver to the Architect as "As-reported Record" drawings. Include dimensions to all buried or concealed conduits to permanent structures.

2. Format for final as-built drawings shall be original PDF drawings, bookmarked per drawing sheet, marked up in PDF software such as Bluebeam. Scanned redline markups will not be acceptable.

D. Operation and Maintenance Manuals

1. At completion of project, prepare Operation and Maintenance Manuals with operation and Maintenance Data, contractors warranties, and copies of approved electrical permits. Include corrected copies of original submittals and shop drawings.

2. Manuals shall be in original, searchable PDF format, bookmarked with Section#, Product Name, ID tag, etc. Scanned pages will not be acceptable. Materials and equipment of each specification section shall be complete prior to submittal. Partial submittals will be marked “Incomplete” and returned for resubmittal.

3. See Division 1 for additional requirements.

3.8 WARRANTIES:

A. Provide a minimum 1-year warranty on all electrical equipment, devices, labor, and work by Division 26 whether specified or not.

B. Provide warranties greater than 1 year as specified in other sections where stated. The warranty requirement most stringent shall be used where conflicts arise.

C. Provide copies of all warranties to the owner upon completion of the project.

3.9 COMPLETION:

A. Complete each system as shown or specified herein and place in operation except where only roughing-in or partial systems are called for. Each system shall be tested and left in proper operation free of faults, shorts or unintentional grounds. Demonstrate system in the presence of the Architect, the Owner or their representative when requested.

3.10 FINAL OBSERVATION:

A. Contractor shall submit written certification that:

1. Contract Documents have been reviewed.

2. Contractor has inspected Project for compliance with Contract Documents.

3. Work has been completed in accordance with Contract Documents.

4. Equipment and Systems have been tested and are operational.

5. Project is completed and ready for final inspection.

B. Architect/Engineer will make final inspection as soon as possible after receipt of Certification.

C. If additional inspections are required because of the Contractor's failure to complete the deficiencies and errors prior to the second inspection, costs for the successive inspections will be back-charged to the Contractor by the Owner, who, in turn, will reimburse the Architect. Charges will be based as follows:

1. Architect/Engineer time at current billing rates.

2. Travel time, and all other expenses incurred in making inspections.

D. Contractor to provide one (1) journeyman, tools, meters, instruments and other test equipment required by Architect. Contractor to remove and replace trims, covers, fixtures, etc., for Architect to review and test materials, systems, methods and workmanship. (Example:

Removing switchboard and panel covers to take voltage/amp readings, review connections and wire size, etc.)

END OF SECTION 26 00 00

SECTION 26 0500
COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Electrical equipment coordination and installation.
2. Sleeves for raceways and cables.
3. Sleeve seals.
4. Grout.
5. Common electrical installation requirements.

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.4 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate electrical connections to equipment:

1. Refer to equipment manufacturer's shop drawings and written instructions. Provide all power and control wiring with associated raceways for complete operation.

2. Verify electrical requirements of equipment on nameplate and installation manual. Ensure that the electrical connections meet the requirements and notify Engineer of any discrepancies.

3. Meet with equipment manufacturers representatives to coordinate equipment installation and electrical connections.

C. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping".

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel.

1. Minimum Metal Thickness:

a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).

b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE SEALS

A. Description: Modular, water tight sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Advance Products & Systems, Inc.

b. Calpico, Inc.

c. Metraflex Co.

d. O-Z Gedney

e. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.

3. Pressure Plates: Carbon steel. Include two for each sealing element.

4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

E. Cut sleeves to length for mounting flush with both surfaces of walls.

F. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.

G. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable, unless indicated otherwise.

H. Seal space outside of sleeves with grout for penetrations of concrete and masonry

1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.

I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants.".

J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."

K. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

L. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals. Install water-tight assembly.

1. Slope underground conduits away from building to prevent accumulated water from traveling down conduit into building.

3.3 SLEEVE-SEAL INSTALLATION

A. Install to seal exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION 26 0500

SECTION 26 0519
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Building wire rated 600 V and less.
2. Metal-clad cable, Type MC, rated 600 V or less.
3. Connectors, splices, and terminations rated 600 V and less.

B. Related Requirements:

1. Division 26 Section "Medium-Voltage Cables" for single-conductor cables, cable splices, and terminations for electrical distribution systems with 601 to 35,000 V.

1.3 DEFINITIONS

A. PV: Photovoltaic.

B. RoHS: Restriction of Hazardous Substances.

C. VFC: Variable-frequency controller.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: Indicate type, use, location, and termination locations.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

C. Testing Agency Qualifications: Member company of NETA.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.7 COORDINATION

A. MC Cable shall not be used unless specifically approved by electrical engineer through the DFCM Project Manager in writing prior to bid.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Insulated Wire Corp.; a Leviton Company.
2. Cerro Wire, LLC
3. General Cable Corporation.
4. Senator Wire & Cable Company.
5. Southwire Company.

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. RoHS compliant.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required. Nonmetallic-sheathed cable is not permitted.

E. Copper Conductors: complying with ASTM B 3 for bare annealed copper and with ASTM B 8 or ASTM B 496 (as applicable) for stranded conductors.

F. Conductor Insulation: Comply with UL 83 and UL 44 for Types THHN-THWN-2, XHHW-2 CT rated, and SO.

G. Aluminum Conductors (APPROVED ONLY WHERE SHOWN FOR PROJECT): Complying with ASTM B 800 and ASTM B 801.

1. May be substituted in 100-400 amp branch panelboard feeder applications where shown on drawings.
2. May be used for feeders above 400A where shown on drawings.
3. Shall not be used for feeders below 100A.
4. Shall not be used for elevator feeders.
5. Shall not be used for mechanical equipment feeders or branch circuits.

H. Aluminum Conductor Insulation: Comply with UL 83 and UL 44 for Type XHHW-2.

I. Cables installed in cable tray shall be rated for “Cable Tray” use, CT listed.

J. Multiconductor Cable: Type SO with ground wire.

2.2 METAL-CLAD CABLE, TYPE MC – APPROVED ON PROJECT AS SHOWN IN THIS SECTION ONLY

A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.

B. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. AFC Cable Systems, Inc.
2. Encore Wire corporation
3. General Cable Technologies Corporation.
4. Southwire Incorporated.
5. Cerro Wire, LLC
6. Senator Wire & Cable Company

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Comply with UL 1569.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Circuits

1. Single circuit and multicircuit with color-coded conductors.
2. Power-Limited Fire-Alarm Circuits: Comply with UL 1424.

E. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.

F. Ground Conductor: Insulated.

G. Conductor Insulation:

1. Type THHN/THWN-2 and XHHW/XHHW-2: Comply with UL 83.

H. Armor: Steel, interlocked.

I. Allowed Uses:

1. Where concealed in hollow stud walls and above accessible ceilings for branch circuits up to 20 A.
    a. Exception: Provide single conductor building wire in raceway for circuit homerun from first outlet to panelboard (no MC cable in electrical rooms or homeruns).

2. MC cable may be used for the final 5ft (“lighting whip”) of recessed light fixtures.

J. In addition to other applicable restrictions, may not be used:

1. Where not approved for use by the authority having jurisdiction.

2. Where exposed to view except in dedicated electrical communications and mechanical rooms where not subject to damage.

3. Where exposed to damage.

4. For damp, wet, or corrosive locations, unless provided with a PVC jacket listed as suitable for those locations.

5. For isolated ground circuits, unless provided with an additional isolated/insulated grounding conductor.

2.3 CONNECTORS AND SPLICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems, Inc.

2. Hubbell Power Systems, Inc.

3. O-Z/Gedney; EGS Electrical Group LLC.

4. 3M; Electrical Products Division.

5. Tyco Electronics Corp.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Service and Feeders: Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Panelboard Feeders 100A through 400A: Copper or Aluminum (where shown on drawings) for feeders No. 1/0 AWG and larger. Stranded No. 1/0 AWG and larger.

C. Branch Circuits: Copper. Solid for No. 12 AWG and smaller; solid or stranded for No. 10 AWG and smaller.

D. VFC Output Circuits Cable: Extra-flexible stranded for all sizes.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THHN-2-THWN-2, single conductors in raceway.

B. Feeders: Type THHN-THWN-2, single conductors in raceway. Type XHHW-2 for aluminum feeders.

C. Branch Circuits: Type THHN-THWN-2, single conductors in raceway.

D. Multi-Wire Branch Circuits: Install no more than three circuits in a raceway, unless specifically shown otherwise.

E. Neutral Conductors: Provide one neutral conductor for each phase conductor. Shared neutral conductors are not allowed.

F. Minimum Branch Circuit Conductor Size: Provide the following minimum sizes for distances listed on 20A branch circuits to prevent excessive voltage drop. The circuit length shall be measured along the length of the conductor form the circuit breaker in the panelboard to the last device on the circuit. Increase raceway size to comply with conductor fill requirements of NFPA 70.

G. Upsizing of Conductors

1. Branch Circuit Voltage of 120V:

   a. Circuit lengths less than 75 feet: Provide minimum #12 AWG conductor size.

   b. Circuit lengths between 75 feet and 140 feet and/or where more than 3 current carrying conductors are installed in a single raceway: Provide minimum #10 AWG conductor size.

   c. Circuit lengths between 140 feet and 200 feet: Provide minimum #8 AWG conductor size.

   d. Circuit lengths greater than 150 feet: Perform voltage drop calculations and provide conductor size to keep branch circuit voltage drop less than 3% with a 15 amp load.

   e. All lighting circuits feeding site lighting at 120V: Provide minimum #10 AWG conductor size for all conductors including equipment ground and upsize per voltage drop above 100 feet.

2. Branch Circuit Voltage of 277V:

   a. Circuit lengths less than 200 feet: Provide minimum #12 AWG conductor size.

   b. Circuit lengths between 200 feet and 280 feet: Provide minimum #10 AWG conductor size.

   c. Circuit lengths between 280 feet and 380 feet: Provide minimum #8 AWG conductor size.

   d. Circuit lengths greater than 380 feet: Perform voltage drop calculations and provide conductor size to keep branch circuit voltage drop less than 3% with a 15 amp load.

e. All lighting circuits feeding site lighting at 277V: Provide minimum #10 AWG conductor size for all conductors including equipment ground and upsize per voltage drop above 240 feet.

H. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless steel, wire-mesh, strain relief device at terminations to suit application.

I. Class 1 Control Circuits: Minimum 14 AWG, Type THHN-THWN-2, in raceway.

J. Class 2 Control Circuits: Per manufacturer, Type THHN-THWN-2, in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Install all conductors and cables in raceways per Division 26 Section, "Raceway and Boxes for Electrical Systems."

B. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

C. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

D. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

E. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

F. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible. Paint to match conduits to surface in finished spaces.

G. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."

H. Complete cable tray systems installation according to Section 260536 "Cable Trays for Electrical Systems" prior to installing conductors and cables.

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

1. Splices for No. 10 AWG and smaller shall be screw on type similar to Scotch or Ideal wing nut connectors.

2. Crimp on splices designed to be used without wire stripping shall not be acceptable.

3. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches (300 mm) of slack.

3.5 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.7 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections and prepare test reports.

C. Tests and Inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors.

2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.

b. Test bolted connections for high resistance using one of the following:

1) A low-resistance ohmmeter.

2) Calibrated torque wrench.

3) Thermographic survey.

c. Inspect compression-applied connectors for correct cable match and indentation.

d. Inspect for correct identification.

e. Inspect cable jacket and condition.

f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration.

g. Continuity test on each conductor and cable.

h. Uniform resistance of parallel conductors.

D. Test Reports: Prepare a written report to record the following:

1. Test procedures used.

2. Test results that comply with requirements.

3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

E. Cables will be considered defective if they do not pass tests and inspections. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 26 05 19

SECTION 26 05 23
CONTROL-VOLTAGE ELECTRICAL POWER CABLES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Low-voltage control cabling.
   2. Control-circuit conductors.
   3. Identification products.

1.02 DEFINITIONS

A. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.
B. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.04 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.05 CLOSEOUT SUBMITTALS

A. Maintenance data.
B. As built drawings indicating conduit sleeve locations, duct mounted sensor locations, temperature well locations, and any locations of device locations and cable routing that does not match the Drawings.

1.06 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of an NRTL.
B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Flame-Spread Index: 25 or less.
   2. Smoke-Developed Index: 50 or less.
C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.
B. Test each pair of UTP cable for open and short circuits.

PART 2 PRODUCTS

2.01 PATHWAYS

A. Support of Open Cabling: NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
   1. Support brackets with cable tie slots for fastening cable ties to brackets.
   2. Lacing bars, spools, J-hooks, and D-rings.
   3. Straps and other devices.
B. Conduit and Boxes: Comply with requirements in Division 26 Sections "Boxes" and "Conduit".
   1. Outlet boxes shall be no smaller than 4 inches wide, 4 inches high, and 2-1/2 inches deep with single-gang mud rings.
   2. Each conduit box must be sealed to prevent air infiltration. Seal conduit entry to box. Fill each box with foam insulation prior to mounting of sensor.
C. Sleeves through block and gypboard wall:
   1. Provide ¾" minimum EMT conduit sleeves with a bushing or insulated fittings on both ends.
   2. Do not share sleeves with fire alarm, IT, AV cabling.

3. Show locations and sizes of sleeves on as-built drawings.

D. Sleeves between floors:
   1. Provide 1” minimum EMT conduit sleeves with a bushing or insulated fittings on both ends.
   2. Do not share sleeves with fire alarm, IT, AV cabling.
   3. Show locations and sizes of sleeves on as-built drawings.

2.02 BACKBOARDS

A. Description: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches. Comply with requirements for plywood backing panels in Division 6 Section "Rough Carpentry."

2.03 CONTROL-CIRCUIT CONDUCTORS

A. Class 1 Control Circuits: Stranded copper, Type THHN-THWN, in raceway, complying with UL 83.
B. Class 2 Control Circuits: Stranded copper, Type THHN-THWN, in raceway, complying with UL 83.
C. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type TW or Type TF, complying with UL 83.

2.04 IDENTIFICATION PRODUCTS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Brady Corporation.
   2. HellermannTyton.
   3. Kroy LLC.
   4. Panduit Corp.
B. Comply with UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
C. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

PART 3 EXECUTION

3.01 INSTALLATION OF PATHWAYS

A. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.
B. Comply with requirements in Division 26 Sections "Boxes" and "Conduit" for installation of conduits and wireways.
C. Install manufactured conduit sweeps and long-radius elbows if possible.

3.02 INSTALLATION OF CONDUCTORS AND CABLES

A. Comply with NECA 1.
B. General Requirements for Cabling:
   1. Comply with TIA/EIA-568-B.1.
   2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
   3. Terminate all conductors; no cable shall contain unterminated elements unless instructed on plans. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
   4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
   5. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
   6. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
   7. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.

8. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. Installation of Control-Circuit Conductors:
   1. Install wiring in raceways.

D. Open-Cable Installation:
   1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
   2. Suspend copper cable not in a wireway or pathway a minimum of 8 inches above ceilings by cable supports not more than 48 inches apart.
   3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

E. Separation from EMI Sources:
   1. Comply with BICSI TDMM and TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
   2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
      a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
      b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
      c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.
   3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
      a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
      b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
      c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.
   4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
      a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
      b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
      c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.
   5. Separation between Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
   6. Separation between Cables and Lighting Fixtures: A minimum of 5 inches.

3.03 CONTROL-CIRCUIT CONDUCTORS

A. Minimum Conductor Sizes:
   1. Class 1 remote-control and signal circuits, No 14 AWG.
   2. Class 2 low-energy, remote-control, and signal circuits, No. 16 AWG.
   3. Class 3 low-energy, remote-control, alarm, and signal circuits, No 12 AWG.

3.04 FIRESTOPPING

A. Comply with requirements in Division 7 Section "Through-Penetration Firestop Systems."

B. Comply with TIA/EIA-569-A, Annex A, "Firestopping."

C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.05 GROUNDING

A. For data communications wiring, comply with ANSI-J-STD-607-A and with BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. For low-voltage wiring and cabling, comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems."

3.06 IDENTIFICATION

A. Identify system components, wiring, and cabling according to TIA/EIA-606-A. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.07 FIELD QUALITY CONTROL

A. Verify that each cable is accurately labeled at each termination and junction box.

END OF SECTION

SECTION 26 0526
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: grounding and bonding systems and equipment.

B. Section includes grounding and bonding systems and equipment, plus the following special applications:

1. Overhead-line grounding.
2. Underground distribution grounding.
3. Ground bonding common with lightning protection system.
4. Foundation steel electrodes.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 INFORMATION SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Comply with NFPA 70 for grounding and bonding of electrical systems.

B. Comply with UL 467 for grounding and bonding materials and equipment.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Burndy; Part of Hubbell Electrical Systems.
2. Dossert; AFL Telecommunications LLC.
3. ERICO International Corporation.
4. Fushi Copperweld Inc.
5. Galvan Industries, Inc.; Electrical Products Division, LLC.
6. Harger Lightning and Grounding.
7. ILSCO.
8. O-Z/Gedney; A Brand of the EGS Electrical Group.
9. Robbins Lightning, Inc.
10. Siemens Power Transmission & Distribution, Inc.
11. VFC, Inc.

2.3 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.
4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches (6.3 by 100 mm) in cross section, with 9/32-inch (7.14-mm) holes spaced 1-1/8 inches (28 mm) apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

2.4 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, pressure type with at least two bolts.

1. Pipe Connectors: Clamp type, sized for pipe.

C. All lugs used in the building system shall be rated for copper only.

D. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

E. Bus-bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

F. Bus-Bar Connectors: Compression type, copper or copper alloy, with two wire terminals.

G. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.

H. Cable-to-Cable Connectors: Compression type, copper or copper alloy.

I. Cable Tray Ground Clamp: Mechanical type, zinc-plated malleable iron.

J. Conduit Hubs: Mechanical type, terminal with threaded hub.

K. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.

L. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.

M. Service Post Connectors: Mechanical type, bronze alloy terminal, in short- and long-stud lengths, capable of single and double conductor connections.

N. Signal Reference Grid Clamp: Mechanical type, stamped-steel terminal with hex head screw.

O. Straps: Solid copper, copper lugs. Rated for 600 A.

P. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.

Q. Water Pipe Clamps:

1. Mechanical type, two pieces with zinc-plated bolts.

a. Material: Tin-plated aluminum.

b. Listed for direct burial.

2. U-bolt type with malleable-iron clamp and copper ground connector rated for direct burial.

2.5 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet (19 mm by 3 m) in diameter.

B. Ground Plates: 1/4 inch (6 mm) thick, hot-dip galvanized.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

B. Underground Grounding Conductors: Install two bare tinned-copper conductors, No. 4/0 AWG minimum.

1. Bury at least 36 inches (900 mm) below grade.

2. Duct-Bank Grounding Conductor: Bury 12 inches (300 mm) above duct bank when indicated as part of duct-bank installation.

3. Terminate Grounds at manholes and building.

C. Isolated Grounding Conductors:

1. Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.

2. Provide IG conductor in addition to the equipment grounding conductor in circuits and feeders serving IG devices and equipment.

D. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Install bus on insulated spacers 2 inches (50 mm) minimum from wall, 6 inches (150 mm) above finished floor unless otherwise indicated.

2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down to specified height above floor; connect to horizontal bus.

E. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.

2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.

3. Connections to Ground Rods at Test Wells: Bolted connectors.

4. Connections to Structural Steel: Welded connectors.

F. Conduits:

1. All metallic conduits shall be properly grounded and bonded.

2. For the following applications a separate code sized insulated ground conductor (in addition to the equipment grounding conductor), shall be terminated to an insulated/isolated ground bus:

a. Conduits serving a 208/120V panels or other feeders.

3.2 GROUNDING AT THE SERVICE

A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 GROUNDING SEPARATELY DERIVED SYSTEMS

A. Generator: Install grounding electrode(s) at the generator location. The electrode shall be connected to the equipment grounding conductor and to the frame of the generator.

3.4 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements.

B. Grounding Manholes and Handholes: Install two driven ground rods through manhole or handhole floor at opposite corners, close to wall, and set rod depth so 4 inches (100 mm) will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 4/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, nonshrink grout. Install 4/0 bare copper conductor around entire manhole, ground all connections and ground rods to this conductor. Ground the duct bank ground conductors to this ground ring as well.

C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.

D. Pad-Mounted Transformers and Switches: Install two ground rods at each pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground duct bank grounding conductors, encased electrode conductors, re-enforcing rebar of equipment pad and other available grounding electrodes.

3.5 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

1. Feeders and branch circuits.
2. Lighting circuits.
3. Receptacle circuits.
4. Single-phase motor and appliance branch circuits.
5. Three-phase motor and appliance branch circuits.

6. Flexible raceway runs.

7. Armored and metal-clad cable runs.

8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.

9. X-Ray Equipment Circuits: Install insulated equipment grounding conductor in circuits supplying x-ray equipment.

C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

D. HVAC Metallic Duct and Pipe Bonding within secure areas: Bond all metallic ductwork and metallic piping within each secure area with #10CU ground and connect to the nearest available ground bus within the secure room.

E. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

F. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

G. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

H. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

I. Signal and Communication Equipment: In addition to grounding and bonding required by NFPA 70, provide a separate grounding system complying with requirements in TIA/ATIS J-STD-607-A.

1. For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.

2. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-4-by-12-inch (6.3-by-100-by-300-mm) grounding bus.

3. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

J. Fence Grounding: Comply with requirements of IEEE C2.

1. Grounding Conductor: Bare, tinned copper, not less than No. 6 AWG.

2. Gates: Shall be bonded to the grounding conductor with a flexible bonding jumper.

3. Barbed Wire: Strands shall be bonded to the grounding conductor.

3.6 INSTALLATION

A. Branch Circuits:

1. Raceways used for single or multiple branch circuits shall include a code sized green insulated ground conductor.

2. Circuits used for isolated ground outlets shall be run in separate raceways; or, shall have a separate green insulated ground conductor installed and tagged with identification at all outlet and junction boxes.

B. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

C. Ground Bonding Common with Existing Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.

D. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.

2. Use exothermic welds for all below-grade connections.

3. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.

2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.

3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

F. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.

3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

G. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

H. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet (18 m) apart.

I. Bonding of Exposed Structural Metal: Bond all exposed structural metal that is not grounded to the service equipment enclosure. The points of attachment of the bonding jumpers shall be accessible.

J. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each steel column, extending around the perimeter of building.

1. Install tinned-copper conductor not less than No. 3/0 AWG for ground ring and for taps to building steel.

2. Bury ground ring not less than 36 inches (900 mm) from building's foundation.

K. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; use a minimum of 20 feet (6 m) of bare copper conductor not smaller than No. 4 AWG.

1. If concrete foundation is less than 20 feet (6 m) long, coil excess conductor within base of foundation.

2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.

3.7 LABELING

A. Comply with requirements in Division 26 Section "Identification for Electrical Systems" Article for instruction signs. The label or its text shall be green.

B. Install labels at the telecommunications bonding conductor and grounding equalizer and at the grounding electrode conductor where exposed.

1. Label Text: "If this connector or cable is loose or if it must be removed for any reason, notify the facility manager."

3.8 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.

2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.

3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal , and at individual ground rods. Make tests at ground rods before any conductors are connected.

a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.

b. Perform tests by fall-of-potential method according to IEEE 81.

4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

D. Grounding system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

F. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.

2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.

3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.

4. Power Distribution Units or Panelboards Serving 120V or 208V equipment: 3 ohm(s).

5. Substations and Pad-Mounted Equipment: 5 ohms.

6. Manhole Grounds: 10 ohms.

G. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 26 05 26

SECTION 26 0529
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.

2. Construction requirements for concrete bases.

B. Related Sections include the following:

1. Section 260548.16 "Seismic Controls for Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:

a. Steel slotted support systems.

b. Clamps

c. Hangers

d. Sockets

e. Eye nuts

f. Fasteners

g. Anchors

h. Saddles

i. Brackets

2. Include rated capacities and furnished specialties and accessories

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details for electrical hangers and support systems and include calculations for the following:

1. Trapeze hangers. Include Product Data for components.

2. Steel slotted channel systems. Include Product Data for components.

3. Nonmetallic slotted channel systems. Include Product Data for components.

4. Equipment supports.

5. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

C. Welding certificates.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Suspended ceiling components.

2. Ductwork, piping, fittings, and supports.

3. Structural members to which hangers and supports will be attached.

4. Size and location of initial access modules for acoustical tile.

5. Items penetrating finished ceiling, including the following:

a. Luminaires

b. Air outlets and inlets

c. Speakers

d. Sprinklers

e. Access Panels

f. Projectors

B. Seismic Qualification Certificates: For hangers and supports for electrical equipment and systems, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Welding Certificates

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M

2. AWS D1.2/D1.2M.

1.7 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design hanger and support system.

B. Seismic Performance: Hangers and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the supported equipment and systems will remain in place without separation of any parts when subjected to the seismic forces specified and the system will be fully operational after the seismic event."

2. Component Importance Factor: 1.5 raceways and equipment connected to an emergency/standby system; 1.0 for other raceways and equipment.

C. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame Rating: Class 1.

2. Self-extinguishing according to ASTM D 635.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Allied Tube & Conduit; a part of Atkore International.

    b. B-line, an Eaton business.

    c. ERICO International Corporation.

    d. GS Metals Corp.

    e. Thomas & Betts Corporation; A Member of the ABB Group

    f. Unistrut; Part of Atkore International.

    g. Wesanco, Inc.

2. Material: Galvanized steel

    a. Stainless steel shall be provided in any corrosive environment

3. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.

4. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.

5. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.

6. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

7. Channel Dimensions: Selected for applicable load criteria.

B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.

F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Hilti Inc.

2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.

3) MKT Fastening, LLC.

4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.

2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Cooper B-Line, Inc.; a division of Cooper Industries.

2) Empire Tool and Manufacturing Co., Inc.

3) Hilti Inc.

4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.

5) MKT Fastening, LLC.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.

4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.

5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.

6. Toggle Bolts: All-steel springhead type.

7. Hanger Rods: Threaded steel.

2.3 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter:

1. NECA 1

2. NECA 101

3. NECA 102

4. NECA 105

5. NECA 111

B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

C. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."

D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMTs, IMCs, and RMCs as scheduled in NECA 1, where its Table 1 lists maximum spacings that are less than those stated in NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.

E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 50 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with two-bolt conduit clamps.

F. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.

2. To New Concrete: Bolt to concrete inserts.

3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.

4. To Existing Concrete: Expansion anchor fasteners.

5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.

6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts Beam, clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69

7. To Light Steel: Sheet metal screws.

8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.

D. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

E. Manhole Requirements:

1. On manhole walls install a minimum of three, evenly spaced, flush cast-in horizontal unistrut cable supports. The lowest support shall be at 12” above the finished floor of the manhole, and the remaining two install at 3’-8” and 6’-4” above manhole floor.

2. In addition, install vertical, surface mounted, unistrut cable supports over the cast-in horizontal supports. Vertical supports shall be installed in a minimum of four columns along each long wall and two columns along each short wall.

3. Support each cable at unistrut cable supports with rubber cush-grips.

4. Ring each cable around the manhole before terminating.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

A. Provide concrete bases for all floor mounted equipment including but not limited to: transformers, switchboards, generators, switches, cabinets, etc.

B. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

C. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete."

D. Anchor equipment to concrete base.

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

2. Install anchor bolts to elevations required for proper attachment to supported equipment.

3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 26 05 29

SECTION 26 0533
RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Metal wireways and auxiliary gutters.
4. Surface raceways.
5. Boxes, enclosures, and cabinets.
6. Handholes and boxes for exterior underground cabling.

B. Related Sections include the following:

1. Section Section 280528 "Pathways for Electronic Safety and Security" for conduits, surface pathways, innerduct, boxes, and faceplate adapters serving electronic safety and security.

1.3 DEFINITIONS

A. ARC: Aluminum rigid conduit.

B. EMT: Electrical metallic tubing.

C. FMC: Flexible metal conduit.

D. GRC (RGS): Galvanized rigid steel conduit.

E. IMC: Intermediate metal conduit.

F. LFMC: Liquidtight flexible metal conduit.

G. RNC: Rigid nonmetallic conduit.

1.4 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor junction boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.

1. Custom enclosures and cabinets.
2. For handholes and boxes for underground wiring, including the following:

a. Duct entry provisions, including locations and duct sizes.

b. Frame and cover design.

c. Grounding details.

d. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.

e. Joint details.

C. Raceway and fitting submittals - Not required.

1.5 INFORMATION SUBMITTALS

A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Structural members in paths of conduit groups with common supports.

2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

B. Qualification Data: For professional engineer.

C. Seismic Qualification Certificates: For enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

4. Detailed description of conduit support devices and interconnections on which the certification is based and their installation requirements.

D. Source quality-control test reports.

PART 2 - PRODUCTS

2.1 METAL CONDUIT, TUBING, AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems, Inc.

2. Alflex Inc.

3. Allied Tube & Conduit; a Tyco International Ltd. Co.

4. Anamet Electrical, Inc.; Anaconda Metal Hose.

5. Electri-Flex Co.

6. Manhattan/CDT/Cole-Flex.

7. Maverick Tube Corporation.

8. O-Z Gedney; a unit of General Signal.

9. Wheatland Tube Company.

B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. GRC: Comply with ANSI C80.1 and UL 6.

D. ARC: Comply with ANSI C80.5 and UL 6A.

E. IMC: Comply with ANSI C80.6 and UL 1242.

F. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.

1. Comply with NEMA RN 1.

2. Coating Thickness: 0.040 inch (1 mm), minimum.

G. EMT: Comply with ANSI C80.3 and UL 797.

H. FMC: Comply with UL 1; Zinc-coated steel.

I. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

J. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: Comply with NEMA FB 1 and UL 514B; listed for type and size raceway with which used, and for application and environment in which installed.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.

2. Fittings for EMT: Steel, set-screw or compression type.

3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.

4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.

K. Joint Compound for IMC, GRC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUIT AND TUBING

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Heritage Plastics
2. AFC Cable Systems, Inc.
3. Anamet Electrical, Inc.; Anaconda Metal Hose.
4. Arnco Corporation.
5. CANTEX Inc.
6. CertainTeed Corp.; Pipe & Plastics Group.
7. Condux International, Inc.
8. ElecSYS, Inc.
9. Electri-Flex Co.
10. Lamson & Sessions; Carlon Electrical Products.
11. Manhattan/CDT/Cole-Flex.
12. Niedax-Kleinhuis USA, Inc
13. RACO; a Hubbell Company.
14. Thomas & Betts Corporation.

B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

D. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

E. Solvents and Adhesives: As recommended by conduit manufacturer.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper B-Line, Inc.
2. Hoffman.
3. Square D; Schneider Electric.
4. Basor Electric, Inc.

B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 or Type 3R as required, and sized according to NFPA 70.

1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Screw-cover type unless otherwise indicated.

E. Finish: Manufacturer's standard enamel finish.

2.4 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

A. Listing and Labeling: Nonmetallic wireways and auxiliary gutters shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Description: Fiberglass polyester, extruded and fabricated to required size and shape, without holes or knockouts. Cover shall be gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections shall be flanged and have stainless-steel screws and oil-resistant gaskets.

C. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.

D. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.

E. Solvents and Adhesives: As recommended by conduit manufacturer.

2.5 SURFACE RACEWAYS

A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Hubbell Incorporated; Wiring Device-Kellems

    b. MonoSystems, Inc

    c. Wiremold / Legrand

2.6 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.

2. EGS/Appleton Electric.

3. Erickson Electrical Equipment Company.

4. Hoffman.

5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.

6. Old Castle Enclosure Solutions.

7. O-Z/Gedney; a unit of General Signal.

8. RACO; a Hubbell Company.

9. Robroy Industries, Inc.; Enclosure Division.

10. Scott Fetzer Co.; Adalet Division.

11. Spring City Electrical Manufacturing Company.

12. Thomas & Betts Corporation.

13. Walker Systems, Inc.; Wiremold Company (The).

14. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.; double-gang, minimum 4-11/16" square boxes with single or double-gang mud ring appropriate for the device and wall plate.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, aluminum, Type FD, with gasketed cover.

E. Metal Floor Junction Boxes:

1. Material: sheet metal.

2. Type: Fully adjustable.

3. Shape: Rectangular.

4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

G. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.

H. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

I. Minimum Device Box Dimensions: 4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep).

J. Gangable boxes are allowed.

K. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 or Type 3R as required by location, with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

2. Nonmetallic Enclosures: Fiberglass.

3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

L. Cabinets:

1. NEMA 250, Type 1 or Type 3R as required by location galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.

2. Hinged door in front cover with flush latch and concealed hinge.

3. Key latch to match panelboards.

4. Metal barriers to separate wiring of different systems and voltage.

5. Accessory feet where required for freestanding equipment.

6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.7 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.

2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Armorcast Products Company.

b. Carson Industries LLC.

c. CDR Systems Corporation.

d. NewBasis.

e. Oldcastle Precast Inc.

2. Standard: Comply with SCTE 77.

3. Configuration: Designed for flush burial with closed bottom unless otherwise indicated.

4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.

5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.

6. Cover Legend: Molded lettering, "ELECTRIC" or "COMMUNICATIONS" as required by service type.

7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

8. Handholes 12 Inches Wide by 24 Inches Long (300 mm Wide by 600 mm Long) and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.8 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.

1. Tests of materials shall be performed by an independent testing agency.

2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.

3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC or IMC.

2. Concealed Conduit, Aboveground: GRC.

3. Underground Conduit: RNC, Type EPC-40-PVC, concrete encased where indicated.

a. Medium-Voltage Duct Banks: Concrete-encased.

b. Communication Duct Banks: Direct Bury.

c. Provide wrapped rigid steel conduit for the following conditions:

1) Penetrations through foundation walls.

2) Bends greater than 22 degrees.

3) Stub ups, or where underground conduits otherwise become exposed.

4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.

5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

6. Application of Handholes and Boxes for Underground Wiring:

a. Polymer concrete, SCTE 77, Tier 15 structural load rating.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:

1. Above 600V, All Locations: GRC.

2. All Feeders and Service Entrance: EMT.

3. Branch Circuits, Exposed, Not Subject to Physical Damage: EMT.

4. Branch Circuits, Exposed and Subject to Physical Damage: Rigid steel conduit. Raceway locations include the following:

a. Loading dock.

b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.

c. Mechanical rooms.

d. Gymnasiums

5. Branch Circuits, Concealed in Ceilings and Interior Walls and Partitions: EMT.

6. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.

7. Damp or Wet Locations: GRC.

8. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.

C. Minimum Raceway Size:

1. 1/2-inch (13-mm) trade size for power branch circuits.

a. 1/2-inch trade size may be used for circuits with a total length of less than 50ft. 1/2" may not be used for homeruns.

2. 3/4-inch (19-mm) trade size for homeruns.

3. 3/8-inch (12-mm) flexible connections to luminaires.

4. 1-inch trade size for outdoor lighting and underground.

5. 1-inch trade size for AV and Data.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.

2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.

3. EMT: Use setscrew or compression, steel fittings. Comply with NEMA FB 2.10.

4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

G. Install surface raceways only where indicated on Drawings.

H. Do not install nonmetallic conduit where ambient temperature exceeds **120 deg F (49 deg C)**

3.2 INSTALLATION

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.

B. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

C. Do not install raceways or electrical items on any "explosion-relief" walls or rotating equipment.

D. Do not fasten conduits onto the bottom side of a metal deck roof.

E. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

F. Complete raceway installation before starting conductor installation.

G. Properly ground raceways as specified in Division 26 Section "Grounding and Bonding for Electrical systems."

H. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

I. Install no more than the equivalent of three 90-degree bends in any conduit run except for communication and control wiring conduits, for which fewer bends are allowed. Support within 12 inches (300 mm) of changes in direction.

J. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.

K. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

L. Support conduit within 12 inches ((300 mm)) of enclosures to which attached.

M. Raceways Embedded in Concrete:

1. Within Slab on Grade (within structural slabs only where approved by Structural Engineer): Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit, or rigid PVC conduit.

2. Within Slab Above Ground(within structural slabs only where approved by Structural Engineer): Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit, rigid PVC conduit, or electrical nonmetallic tubing (ENT).

3. Within Concrete Walls Above Ground: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit, rigid PVC conduit, or electrical nonmetallic tubing (ENT).

4. Where rigid polyvinyl (PVC) conduit is provided, transition to galvanized steel rigid metal conduit where emerging from concrete.

5. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot ((3-m)) intervals.

6. Arrange raceways to cross building expansion joints at right angles with expansion fittings.

7. Arrange raceways to keep a minimum of 1 inch (25 mm) of concrete cover in all directions.

8. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.

9. Change from PVC to GRC before rising above floor.

N. Stub-ups to Above Recessed Ceilings:

1. Use EMT, IMC, or RMC for raceways.

2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

O. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

P. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

Q. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

R. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch (35mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

S. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

T. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

U. Cut conduit perpendicular to the length. For conduits 2-inch (53-mm) trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

V. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 1200-lb (544-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

W. Surface Raceways:

1. Install surface raceway with a minimum 2-inch (50-mm) radius control at bend points.

2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

X. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.

Y. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.

2. Where an underground service raceway enters a building or structure.

3. Conduit extending from interior to exterior of building.

4. Conduit extending into pressurized duct and equipment.

5. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.

6. Where otherwise required by NFPA 70.

Z. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

AA. Expansion-Joint Fittings:

1. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F (55 deg C) and that has straight-run length that exceeds 100 feet (30 m).

2. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.

3. Install expansion fittings at all locations where conduits cross building or structure expansion joints.

4. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

BB. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches (1830 mm) of flexible conduit for recessed and semi-recessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.

CC. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, comply with ADA requirements and refer to Architectural elevations.

DD. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

EE. Boxes in stud walls: Do not install boxes back to back in stud walls. Allow one stud separation or 24" minimum. Where this is not possible, then provide boxes with UL-listed fire rated and sound rated wrapping.

FF. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

GG. Locate boxes so that cover or plate will not span different building finishes.

HH. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

II. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

JJ. Set metal floor boxes level and flush with finished floor surface.

KK. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

LL. Conduits installed with wrinkles or kinks or otherwise in an unprofessional manner shall be replaced by the contractor at no additional cost to the owner.

3.3 INSTALLATION OF RACEWAYS FOR LOW VOLTAGE SYSTEMS

A. All conduits extending from the floor should extend 1-3” AFF and no more than 2” off any wall.

B. Conduit rows should not exceed two deep

C. Conduits that enter a Telecomm Room (TR) should terminate near the corners to allow for proper racking.

D. All pathways must not exceed 295’ from the TR to the com/outlet must not have a bend over 90 degrees or an aggregate of bends in excess of 180 degrees between pull points.

E. Conduit segments will not exceed 100’ without a pull point.

F. Conduit runs should be limited to less than 150’ and no more than 180 degrees in bends total between pull points.

G. All conduits should be equipped with a pull cord that has a minimum rating of 200lbs.

H. A minimum of 1” conduit is required for all Voice/Data locations

I. Wireless locations should be mounted directly to the ceiling or T-bar. Wall mount locations will be approved on a case by case basis in written form.

J. Pathways should be installed at least 3” of clear vertical space above the ceiling tiles and T-bars to ensure accessibility, and should at no point rest or be supported by any component of the suspended ceiling

K. J-hook supports are not acceptable

L. Underground entrances should not have more than 2 - 90 degree bends between pull points

M. All comm. raceways will have a pull rope installed during initial installation (200lb)

3.4 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 31 Section "Earth Moving" for pipe less than 6 inches (150 mm) in nominal diameter.

2. Install backfill as specified in Division 31 Section "Earth Moving."

3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."

4. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.

   a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete.

   b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.

5. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape with detectable metal strip directly above line at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches (400 mm) overall.

3.5 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade.

D. Install handholes and boxes with bottom below the frost line, below grade.

E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.

F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies.

3.7 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.8 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 26 05 33

SECTION 26 0536

CABLE TRAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes steel cable trays and accessories.

1.3 SUBMITTALS

A. Product Data: Include data indicating dimensions and finishes for each type of cable tray indicated.

B. Shop Drawings: For each type of cable tray.

1. Show fabrication and installation details of cable tray, including plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice-plate connectors, expansion-joint assemblies, straight lengths, and fittings.

2. Seismic-Restraint Details: Signed and sealed by a qualified professional engineer, licensed in the state where Project is located, who is responsible for their preparation.

a. Design Calculations: Calculate requirements for selecting seismic restraints.

b. Detail fabrication, including anchorages and attachments to structure and to supported cable trays.

C. Coordination Drawings: Floor plans and sections, drawn to scale. Include scaled cable tray layout and relationships between components and adjacent structural, electrical, and mechanical elements. Show the following:

1. Vertical and horizontal offsets and transitions.

2. Clearances for access above and to side of cable trays.

3. Vertical elevation of cable trays above the floor or bottom of ceiling structure.

D. Field quality-control reports.

E. Operation and Maintenance Data: For cable trays to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain cable tray components through one source from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store indoors to prevent water or other foreign materials from staining or adhering to cable tray. Unpack and dry wet materials before storage.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Chalfant Manufacturing Company.
2. Cooper B-Line, Inc.
3. Cablofil (Legrand)
4. GS Metals Corp.; GLOBETRAY Products.
5. MONO-SYSTEMS, Inc.
6. MPHusky.
7. PW Industries.

2.2 MATERIALS AND FINISHES

A. Wire Mesh Cable Trays, Fittings, and Accessories: Steel wire mesh/basket type, complying with NEMA VE 1.

1. Carbon steel ASTM A510 grade 1008, electroplated zinc complying with ASTM B633.

B. Ladder Cable Tray, Fittings, and Accessories: Aluminum complying with NEMA VE 1.

1. Radius-Fitting Rung: 9 inch (225 mm) spacing at center of tray's width and 7/8 inch (22 mm) width with radius edges.
2. Splicing Assemblies: Bolted type using serrated flange locknuts.

C. Structural Performance of Each Rung: Capable of supporting a maximum cable load, with a safety factor of 1.5, plus a 200 lb. (90 kg) concentrated load, when tested in accordance with NEMA VE 1.

1. Splice-Plate Capacity: Splices located within support span must not diminish rated loading capacity of cable tray.

D. Sizes and Configurations: Refer to Drawings for specific requirements for types, materials, sizes, and configurations. Where not indicated, provide the following size:

1. 18" wide x 4" deep.

E. Provide trapeze style support for cable trays.

2.3 CABLE TRAY ACCESSORIES

A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray. Provide factory fittings, elbows, 90s, sweeps, waterfalls, etc. No field modified fittings.

B. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

C. Dividers: Provide factory cable tray dividers including all fittings and connectors compatible with cable tray.

1. All cable trays shall have dividers included to partition the cable tray into two separate sections.

2.4 SOURCE QUALITY CONTROL

A. Perform design and production tests according to NEMA VE 1.

PART 3 - EXECUTION

3.1 CABLE TRAY INSTALLATION

A. Comply with recommendations in NEMA VE 2. Install as a complete system, including all necessary fasteners, hold-down clips, splice-plate support systems, barrier strips, hinged horizontal and vertical splice plates, elbows, reducers, tees, and crosses.

B. Drawings show general cable tray layout and do not detail changes in elevation or offsets required to maneuver around structure and work of other trades. Coordinate cable tray layout with other construction elements and include transitions, offsets and changes in elevation.

C. Elevation changes and offsets must be kept to a minimum.

D. Tray should extend at least 1” into the TR then waterfall to 8’ to accommodate internal racking.

E. Remove burrs and sharp edges from cable trays.

F. Install dividers in all cable trays following manufacturer instructions.

G. Fasten cable tray supports to building structure and install seismic restraints.

1. Design each fastener and support to carry load indicated by seismic requirements and to comply with seismic-restraint details according to Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

2. Place supports so that spans do not exceed cable tray ratings with installed weight load.

3. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.

4. Support bus assembly to prevent twisting from eccentric loading.

5. Manufacture center-hung support, designed for 60 percent versus 40 percent eccentric loading condition, with a safety factor of 3.

6. Locate and install supports according to NEMA VE 1.

H. Make connections to equipment with flanged fittings fastened to cable tray and to equipment. Support cable tray independent of fittings. Do not carry weight of cable tray on equipment enclosure.

I. Install expansion connectors where cable tray crosses building expansion joint and in cable tray runs that exceed dimensions recommended in NEMA VE 1. Space connectors and set gaps according to applicable standard.

J. Make changes in direction and elevation using standard fittings.

K. Make cable tray connections using standard fittings.

L. Cable Trays Above Accessible Ceilings:

1. Locate bottom of cable tray between 3" - 12" above accessible ceiling tile such that ceiling tile can be removed and cable tray can be accessed.

2. Locate cable tray at least 3" below perpendicular piping and duct work crossing so that top of tray can be accessed.

a. Maintain 12” minimum clearance above cable tray for its entire length except for direct crossings, but should impact no more than 4ft of the cable tray.

3. Maintain at least 12" separation from lighting fixtures.

4. Maintain at least 3" separation from branch circuits, and 18" separation from feeders.

5. Maintain at least 18” of side clearance for cable tray for access into cable tray.

M. Seal penetrations through fire and smoke barriers according to Division 07 Section "Penetration Firestopping."

N. Sleeves for Future Cables: Install capped sleeves for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.

O. Workspace: Install cable trays with enough space to permit access for installing cables.

P. Grounding and Bonding: bond cable tray to telecomm grounding system. Each conduit shall be bonded to cable tray with #8 cable for all low voltage cabling systems utilizing the cable tray.

3.2 CABLE INSTALLATION

A. Install cables only when cable tray installation has been completed and inspected.

B. Fasten cables on horizontal runs with cable clamps or cable ties as recommended by NEMA VE 2. Tighten clamps only enough to secure the cable, without indenting the cable jacket. Install cable ties with a tool that includes an automatic pressure-limiting device.

C. On vertical runs, fasten cables to tray every 18 inches (457 mm). Install intermediate supports when cable weight exceeds the load-carrying capacity of the tray rungs.

D. In existing construction, remove inactive or dead cables from cable tray.

E. The inside of a cable tray must be free of burrs, sharp edges, or projections that can damage the cable during installation.

F. When cable tray is used, conduit should extend from the telecom outlet located in the work area, directly to the cable tray.

G. Trays should be supported every 5’ and within 24” on each side of a fitting (unless otherwise noted by the manufacture)

H. All metallic cable trays must be grounded, marked and all sections bonded in accordance with applicable codes, standards and regulations.

I. Pathways should be kept in common areas to avoid future maintenance occurring in private work areas.

J. Trays should be sized to be at no more than 40% fill.

3.3 CONNECTIONS

A. Ground cable trays according to manufacturer's written instructions.

1. Bond discontinuous sections of cable trays together so that cable tray is electrically continuous.

2. Bond cable trays to sections of metal raceways that are part of the cable pathway system.

3.4 FIELD QUALITY CONTROL

A. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements. Perform the following field quality-control survey:

1. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable tray, vibration, and thermal expansion and contraction conditions, which may cause or have caused damage.

2. Verify that the number, size, and voltage of cables in cable tray do not exceed that permitted by NFPA 70. Verify that communication or data-processing circuits are separated from power circuits by barriers.

3. Verify that there is no intrusion of such items as pipe, hangers, or other equipment that could damage cables.

4. Remove deposits of dust, industrial process materials, trash of any description, and any blockage of tray ventilation.

5. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorque in suspect areas.

6. Check for missing or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.

7. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable tray.

3.5 PROTECTION

A. Protect installed cable trays.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.

2. Install temporary protection for cables in open trays to protect exposed cables from falling objects or debris during construction. Temporary protection for cables and cable tray can be constructed of wood or metal materials until the risk of damage is over.

END OF SECTION 26 05 36

SECTION 26 0543
UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal conduits and fittings, including GRC and PVC-coated steel conduit.
2. Rigid nonmetallic duct.
3. Flexible nonmetallic duct.
4. Duct accessories.
5. Precast concrete handholes.
6. Polymer concrete handholes and boxes with polymer concrete cover.
7. Fiberglass handholes and boxes with polymer concrete cover.
8. Fiberglass handholes and boxes.
9. High-density plastic boxes.
10. Precast manholes.
11. Cast-in-place manholes.
12. Utility structure accessories.

1.3 DEFINITION

A. Direct Buried: Duct or a duct bank that is buried in the ground, without any additional casing materials such as concrete.

B. Duct: A single duct or multiple ducts. Duct may be either installed singly or as component of a duct bank.

C. Duct Bank:

1. Two or more ducts installed in parallel, with or without additional casing materials.
2. Multiple duct banks.

D. GRC: Galvanized rigid (steel) conduit.

E. Trafficways: Locations where vehicular or pedestrian traffic is a normal course of events.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include duct-bank materials, including spacers and miscellaneous components.

2. Include duct, conduits, and their accessories, including elbows, end bells, bends, fittings, and solvent cement.

B. Shop Drawings for Factory-Fabricated Handholes and Pull Boxes Other Than Precast Concrete: Include dimensioned plans, sections, and elevations, and fabrication and installation details, including the following:

1. Duct entry provisions, including locations and duct sizes.

2. Reinforcement details.

3. Frame and cover design and manhole frame support rings.

4. Ladder details.

5. Grounding details.

6. Dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.

7. Joint details.

8. Structural Calculations for Manholes: Submit structural calculations based on the 2012 IBC, stamped and signed by a Structural Engineer in the State of Utah.

C. Product Data: For the following:

1. Duct-bank materials, including separators and miscellaneous components.

2. Ducts and conduits and their accessories, including elbows, end bells, bends, fittings, and solvent cement.

3. Accessories for manholes, handholes, pull boxes, and other utility structures.

4. Warning tape.

5. Warning planks.

D. Duct-Bank Coordination Drawings: Show duct profiles and coordination with other utilities and underground structures.

1. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings.

E. Product Certificates: For concrete and steel used in precast concrete manholes, pull boxes and handholes, comply with ASTM C 858.

F. Source quality-control reports.

G. Field quality-control reports.

H. ICC Evaluation Reports: For damp-proofing and water-proofing materials, submit ICC evaluation reports to Engineer and DFCM as a deferred submittal.

1.5 QUALITY ASSURANCE

A. Comply with IEEE C2.

B. Comply with NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver ducts to Project site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.

B. Store precast concrete and other factory-fabricated underground utility structures at Project site as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.

C. Lift and support precast concrete units only at designated lifting or supporting points.

1.7 PROJECT CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify Engineer and Owner no fewer than two weeks in advance of proposed interruption of electrical service.

2. Do not proceed with interruption of electrical service without Owner's written permission.

1.8 COORDINATION

A. Coordinate layout and installation of ducts, manholes, handholes, and pull boxes with final arrangement of other utilities, site grading, and surface features as determined in the field.

B. Coordinate elevations of ducts and duct-bank entrances into manholes, handholes, and pull boxes with final locations and profiles of ducts and duct banks as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations from those indicated as required to suit field conditions and to ensure that duct runs drain to manholes and handholes, and as approved by Architect.

PART 2 - PRODUCTS

2.1 CONDUIT

A. Rigid Steel Conduit: Galvanized. Comply with ANSI C80.1.

B. RNC: NEMA TC 2, Type EPC-40-PVC and Type EPC-80-PVC, UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

2.2 NONMETALLIC DUCTS AND DUCT ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems.
2. ARNCO Corporation.
3. Beck Manufacturing.
4. Cantex, Inc.
5. CertainTeed Corp.
6. Condux International, Inc.
7. DCX-CHOL Enterprises, Inc.; ELECSYS Division.
8. Electri-Flex Company.
9. IPEX Inc.
10. Lamson & Sessions; Carlon Electrical Products.
11. Manhattan Wire Products; a Belden company.

B. Duct Accessories:

1. Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and sizes of ducts with which used, and retained to provide minimum duct spacings indicated while supporting ducts during concreting or backfilling.
2. Warning Tape: Underground-line warning tape specified in Division 26 Section "Identification for Electrical Systems."

2.3 PRECAST CONCRETE HANDHOLES AND PULL BOXES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Christy Concrete Products.
2. Cretex Concrete Products West, Inc.; Riverton Division.
3. Elmhurst-Chicago Stone Co.
4. Oldcastle Precast Group.
5. Oldcastle Precast Inc.; Utility Vault Division.
6. Utility Concrete Products, LLC.
7. Wausau Tile Inc.

B. Comply with ASTM C 858 for design and manufacturing processes.

C. Ferrous metal hardware shall be hot-dip galvanized in accordance with ASTM A153 (ASTM A153M) and ASTM A123 (ASTM A123M).

D. Description: Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom unless open-bottom enclosures are indicated. Frame and cover shall form top of enclosure and shall have load rating consistent with that of handhole or pull box.

1. Frame and Cover: Weatherproof cast-iron frame, with cast-iron cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing stainless-steel bolts.

2. Frame and Cover: Weatherproof steel frame, with hinged steel access door assembly with tamper-resistant, captive, cover-securing stainless-steel bolts.

   a. Cover Hinges: Concealed, with hold-open ratchet assembly.

   b. Cover Handle: Recessed.

3. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.

4. Cover Legend: Molded lettering, "ELECTRIC" or "TELEPHONE" as required for each service.

5. Configuration: Units shall be designed for flush burial and have closed bottom unless otherwise indicated.

6. Extensions and Slabs: Designed to mate with bottom of enclosure. Same material as enclosure.

   a. Extension shall provide increased depth of 12 inches (300 mm).

   b. Slab: Same dimensions as bottom of enclosure, and arranged to provide closure.

7. Windows: Precast openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks plus an additional 12 inches (300 mm) vertically and horizontally to accommodate alignment variations.

   a. Windows shall be located no less than 6 inches (150 mm) from interior surfaces of walls, floors, or frames and covers of handholes, but close enough to corners to facilitate racking of cables on walls.

   b. Window opening shall have cast-in-place, welded wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct banks.

   c. Window openings shall be framed with at least two additional No. 4 steel reinforcing bars in concrete around each opening.

8. Duct Entrances in Handhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.

   a. Type and size shall match fittings to duct or conduit to be terminated.

   b. Fittings shall align with elevations of approaching ducts and be located near interior corners of handholes to facilitate racking of cable.

9. Handholes 12 inches wide by 24 inches long (300 mm wide by 600 mm long) and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

PART 3 - EXECUTION

3.1 CORROSION PROTECTION

A. Aluminum shall not be installed in contact with earth or concrete.

3.2 UNDERGROUND DUCT APPLICATION

A. Ducts for Electrical Cables over 600 V: RNC, NEMA Type EPC-40-PVC, in concrete-encased duct bank unless otherwise indicated.

B. Underground Ducts for Telephone, Communications, or Data Utility Service Cables: RNC, NEMA Type EPC-40-PVC, in concrete-encased duct bank unless otherwise indicated.

3.3 UNDERGROUND ENCLOSURE APPLICATION

A. Handholes and Pull Boxes for 600 V and Less:

1. Units in Roadways and Other Deliberate Traffic Paths: Precast concrete. AASHTO HB 17, H-20 structural load rating.

2. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Precast concrete, AASHTO HB 17, H-20 structural load rating.

3. Units in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Precast concrete, AASHTO HB 17, H-10 structural load rating.

B. Manholes:

1. Units Located in Roadways and Other Deliberate Traffic Paths by Heavy or Medium Vehicles: H-20 structural load rating according to AASHTO HB 17.

2. Units Not Located in Deliberate Traffic Paths by Heavy or Medium Vehicles: H-10 load rating according to AASHTO HB 17.

3. All new manholes shall be pre-cast concrete units. Where pre-cast cannot be used due to restricted site access or other obstructions, then cast-in-place manholes may be used, however, contractor shall submit shop drawings and design along with structural calculations stamped by a Structural Engineer for review.

3.4 EARTHWORK

A. Excavation and Backfill: Comply with Division 31 Section "Earth Moving," but do not use heavy-duty, hydraulic-operated, compaction equipment.

B. Restore surface features at areas disturbed by excavation and reestablish original grades unless otherwise indicated. Replace removed sod immediately after backfilling is completed.

C. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Division 32 Sections "Turf and Grasses" and "Plants."

D. Cut and patch existing pavement in the path of underground ducts and utility structures according to Division 01 Section "Cutting and Patching."

3.5 DUCT INSTALLATION

A. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes to drain in both directions.

B. Curves and Bends: Use 5-degree angle couplings for small changes in direction. For turns greater than 30 degrees use manufactured wrapped rigid metal long sweep bends with a minimum radius of 48 inches (1220 mm), both horizontally and vertically, at other locations unless otherwise indicated.

C. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.

D. Duct Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches (250 mm) o.c. for 5-inch (125-mm) ducts, and vary proportionately for other duct sizes.

1. Begin change from regular spacing to end-bell spacing 10 ft. (3 m) from the end bell without reducing duct line slope and without forming a trap in the line.

2. Grout end bells into structure walls from both sides to provide watertight entrances.

E. Building Wall and Manhole Penetrations: Make a transition from underground duct to rigid steel conduit, wrapped in PVC tape at least 10 ft. (3 m) outside the building wall without reducing duct line slope away from the building and without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition. Terminate with flush bell ends. Install conduit penetrations of building walls as specified in Division 26 Section "Common Work Results for Electrical."

F. Sealing: Provide temporary closure at terminations of ducts that have cables pulled with Sika “Sikadur Combiflex” sealing system or prior approved equal. Seal spare ducts at terminations with UL approved plugs to withstand at least 15-psig (1.03-MPa) hydrostatic pressure and seal with silicon sealant.

G. After installation of duct bank, pull a mandrel through each duct to ensure that no debris has collected in the duct. Then install pull cord and label at each end with date installed. Install a plastic conduit plug at each end of the rope and seal the plugs to each end of all unused conduits with silicone sealant.

H. Pulling Cord: Install *2500-lb- mule tape with lineal footage markings* in ducts, including spares.

I. Concrete-Encased Ducts: Support ducts on duct separators.

1. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, with not less than 4 spacers per 20 ft. (6 m) of duct. Secure separators to earth and to ducts to prevent floating during concreting. Stagger separators approximately 6 inches (150 mm) between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.

2. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.

   a. Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written recommendations, or use other specific measures to prevent expansion-contraction damage.

   b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch (19-mm) reinforcing rod dowels extending 18 inches (450 mm) into concrete on both sides of joint near corners of envelope.

3. Pouring Concrete: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Use a plank to direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application.

4. Mix red dye in concrete..

5. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.

6. Minimum Space between Ducts: 4 inches (100 mm) between ducts and exterior envelope wall, 3 inches (75 mm) between ducts for like services, and 24 inches (300 mm) between power and signal ducts.

7. Depth, 600V and Below: Install top of duct bank at least 24 inches (600 mm) below finished grade in areas not subject to deliberate traffic, and at least 30 inches (750 mm) below finished grade in deliberate traffic paths for vehicles unless otherwise indicated.

8. Depth, Above 600V: Install top of duct bank at least 36 inches (1200 mm) below finished grade unless otherwise indicated.

9. Stub-Ups: Use manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.

a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete.

b. Stub-Ups to Equipment: For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of base. Install insulated grounding bushings on terminations at equipment.

10. Warning Ribbon: Bury yellow metallic locator ribbon directly above centerline of duct bank 12” below finished grade.

3.6 INSTALLATION OF CONCRETE MANHOLES, HANDHOLES, AND PULL BOXES

A. Precast Concrete Handhole and Manhole Installation:

1. Comply with ASTM C 891 unless otherwise indicated.

2. Install units level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances.

3. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1-inch (25-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

B. Elevations:

1. Install handholes with bottom below the frost line, below grade.

2. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes 1 inch (25 mm) above finished grade.

3. Where indicated, cast handhole cover frame integrally with handhole structure.

C. Drainage: Provide the following and coordinate with rock sump provided under manhole floor.

1. Install grate drains in bottom of manholes where indicated.

2. Install full size drain connection to entry hatch 1-1/2” welded drain couplings.

D. Manhole Access: Circular opening in manhole roof; sized to match cover size.

1. Manholes with Fixed Ladders: Offset access opening from manhole centerlines to align with ladder.

2. Install chimney, constructed of precast concrete collars and rings to support frame and cover and to connect cover with manhole roof opening. Provide moisture-tight masonry joints and waterproof grouting for cast-iron frame to chimney.

E. Waterproofing: After ducts have been connected and grouted, and before backfilling, waterproof openings, *penetrations*, joints and connections and touch up abrasions and scars. Waterproof exterior of manhole chimneys after mortar has cured at least three days.

1. Waterproof joints, connections and openings with "Sikadur Combiflex" sealing system.

2. For new manholes: Apply damp proofing to entire manhole with Henry HE 789 damp proof coating or equivalent.Coordinate first paragraph below with Drawings. Delete second option if nonmetallic cable racks are specified.

F. Hardware: Install removable hardware, including pulling eyes, cable stanchions, and cable arms, and insulators, as required for installation and support of cables and conductors and as indicated.Delete first paragraph below if manhole ladder locations are detailed on Drawings.

G. Fixed Manhole Ladders: Arrange to provide for safe entry with maximum clearance from cables and other items in manholes.

H. Field-Installed Bolting Anchors in Manholes and Concrete Handholes: Do not drill deeper than 3-7/8 inches (98 mm) for manholes and 2 inches (50 mm) for handholes, for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.

I. Warning Sign: Install "Confined Space Hazard" warning sign on the inside surface of each manhole cover.

3.7 GROUNDING

A. Ground underground ducts and utility structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

3.8 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.

2. Pull aluminum or wood test mandrel through duct to prove joint integrity and test for out-of-round duct. Test mandrel shall be not less than 12 inches long, and diameter shall not be less than 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.

3. Test manhole and handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Division 26 Section "Grounding and Bonding for Electrical Systems."

B. Correct deficiencies and retest as specified above to demonstrate compliance.

C. Prepare test and inspection reports.

3.9 CLEANING

A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

B. Clean internal surfaces of manholes, including sump. Remove foreign material.

END OF SECTION 26 05 43

SECTION 26 05 44

SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:

1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

D. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

F. Sleeves for Rectangular Openings:

1. Material: Galvanized sheet steel.

2. Minimum Metal Thickness:

a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and with no side larger than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).

b. For sleeve cross-section rectangle perimeter 50 inches (1270 mm) or more and one or more sides larger than 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

2. Pressure Plates: Carbon steel.

3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

2.4 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.

B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:

1. Interior Penetrations of Non-Fire-Rated Walls and Floors:

a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."

b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

3. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.

4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.

5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level. Install sleeves during erection of floors.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.

2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 26 05 44

SECTION 26 0548

VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Isolation pads.
2. Spring isolators.
3. Restrained spring isolators.
4. Channel support systems.
5. Restraint cables.
6. Hanger rod stiffeners.
7. Anchorage bushings and washers.

B. Related Sections include the following:

1. Division 26 Section "Hangers And Supports For Electrical Systems" for commonly used electrical supports and installation requirements.

1.3 DEFINITIONS

A. The IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading: Refer to project Structural Drawings and Specifications for the following, as defined in the IBC:

1. Site Class: As indicated in structural project documents
2. Assigned Seismic Use Group or Building Category.
    a. Component Response Modification Factor: As indicated in structural project documents
    b. Component Amplification Factor: As indicated in structural project documents
3. Design Spectral Response Acceleration at Short Periods (0.2 Second): As indicated in structural project documents

4. Design Spectral Response Acceleration at 1.0-Second Period: As indicated in structural project documents

B. Component Importance Factor:

1. In order to identify systems requiring seismic restraint and to define those from which restraints may be excluded, utility components are assigned an ASCE 7 Importance Factor (Ip) on the basis of the following:

a. Ip = 1.5

1) essential facilities required for post earthquake recovery – all components required for the continued operation of the facility.

2) Life-safety components which are required to function after a seismic event including all equipment feeding and connected to the life safety branch of the electrical system.

3) All equipment feeding and connected to the stand-by branch of the electrical system.

b. Ip = 1.0 All other components.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.

2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.

a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.

b. Annotate to indicate application of each product submitted and compliance with requirements.

3. Restrained-Isolation Devices: Include ratings for horizontal, vertical, and combined loads.

B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators and seismic restraints.

a. Coordinate design calculations with wind-load calculations required for equipment mounted outdoors. Comply with requirements in other Division 26 Sections for equipment mounted outdoors.

2. Provide Seismic Design Force calculations per ASCE 7- [02, Formulas 9.6.1.3-1 thru 9.6.1.3-3] [05, Formulas 13.3-1 thru 13.3-3].

3. Indicate materials and dimensions and identify hardware, including attachment and anchorage devices.

4. Field-fabricated supports.

5. Seismic-Restraint Details:

   a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.

   b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.

   c. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

C. Deferred Submittals shall be as required by IBC 107.3.4.2.

1. Deferred submittals of seismic restraint of nonstructural components must be submitted to the Building Official a minimum of two weeks prior to the planned installation in order to allow for plan review and forwarding to inspectors. In the event that the submittal is deficient additional time may become necessary.

2. No deferred submittal element shall be installed until Building Official approval has been received.

3. If seismic restraints of nonstructural components are installed prior to receiving approval they shall not be covered or concealed until plan review and inspection approval. Further, installers are proceeding at their own risk until plan review and inspection approval occurs.

4. Deferred Submittals are required for:

   a. Electrical distribution equipment (switchgear, panelboards, transformers, MCC's etc.).

   b. Conduit racks.

   c. Cable trays.

   d. Lighting and other Concrete Pole Bases.

   e. Lighting – pendants, etc.

D. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints.

E. Welding certificates.

F. Qualification Data: For professional engineer.

G. Field quality-control test reports.

1.6 QUALITY ASSURANCE

A. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing seismic engineering services, including the design of seismic restraints, that are similar to those indicated for this Project.

B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

D. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ace Mountings Co., Inc.
2. Amber/Booth Company, Inc.
3. California Dynamics Corporation.
4. Isolation Technology, Inc.
5. Kinetics Noise Control.
6. Mason Industries.
7. Vibration Eliminator Co., Inc.
8. Vibration Isolation.
9. Vibration Mountings & Controls, Inc.

B. Pads: Arrange in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.

1. Resilient Material: Oil- and water-resistant neoprene.

C. Spring Isolators: Freestanding, laterally stable, open-spring isolators.

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

2. Minimum Additional Travel: 50 percent of the required deflection at rated load.

3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- (6-mm-) thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig (3447 kPa).

6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

D. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.

1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch- (6-mm-) thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.

2. Restraint: Seismic or limit-stop as required for equipment and authorities having jurisdiction.

3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

4. Minimum Additional Travel: 50 percent of the required deflection at rated load.

5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.2 SEISMIC-RESTRAINT DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Amber/Booth Company, Inc.

2. California Dynamics Corporation.

3. Cooper B-Line, Inc.; a division of Cooper Industries.

4. Hilti Inc.

5. ISAT.

6. Loos & Co.; Seismic Earthquake Division.

7. Mason Industries.

8. TOLCO Incorporated; a brand of NIBCO INC.

9. Unistrut; Tyco International, Ltd.

B. General Requirements for Restraint Components: Rated strengths, features, and application requirements shall be as defined in reports by an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

C. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

D. Restraint Cables: ASTM A 603 galvanized-steel cables with end connections made of steel assemblies with thimbles, brackets, swivels, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.

E. Hanger Rod Stiffener: [Steel tube or steel slotted-support-system sleeve with internally bolted connections] [Reinforcing steel angle clamped] to hanger rod. Do not weld stiffeners to rods.

F. Bushings for Floor-Mounted Equipment Anchor: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchors and studs.

G. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices.

H. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

I. Mechanical Anchor: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchors with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

J. Adhesive Anchor: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.3 FACTORY FINISHES

A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.

1. Powder coating on springs and housings.

2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.

3. Baked enamel or powder coat for metal components on isolators for interior use.

4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Equipment and Hanger Restraints:

1. Install restrained isolators on electrical equipment.

2. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).

3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

B. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

C. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

D. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during

coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.

2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.

4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.

5. Set anchors to manufacturer's recommended torque, using a torque wrench.

6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where they terminate with connection to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.5 ADJUSTING

A. Adjust isolators after isolated equipment is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust active height of spring isolators.

D. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.6 SPECIAL INSPECTION

A. Per the requirements of ASCE 7, the building owner will employ a special inspector(s) to observe the construction of all Designated Seismic Systems in accordance with the Quality Assurance Plan.

END OF SECTION 26 05 48

SECTION 26 0553

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Underground-line warning tape.
5. Warning labels and signs.
6. Instruction signs.
7. Equipment identification labels.
8. Miscellaneous identification products.

1.3 SUBMITTALS

A. Product Data and Examples: For each major type of label, include dimensions and type of label to be provided. Provide examples of the following labels at a minimum:

1. Panelboard/Switchboard
2. Motor Control Center
3. Generator
4. Enclosed switches, disconnect switches, circuit breakers and motor controllers
5. Electric Meters
6. Arc Flash
7. Medium Voltage

1.4 QUALITY ASSURANCE

A. Comply with ANSI A13.1.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.5 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT

A. Identify all equipment with labels per drawings.

B. Use typewritten card stock circuit directory to identify loads.

2.2 POWER RACEWAY IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.

B. Colors for Raceways Carrying Circuits at More Than 600 V (where exposed):

1. White letters on painted red raceways.

2. Legend: "DANGER HIGH VOLTAGE WIRING" with 3-inch- (75-mm-) high letters on 20-inch (500-mm) centers.

2.3 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

C. Write-On Tags: Polyester tag, 0.010 inch (0.25 mm) thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.

1. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.4 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.

B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

C. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

D. Write-On Tags: Polyester tag, 0.010 inch (0.25 mm) thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.

1. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.5 UNDERGROUND-LINE WARNING TAPE

A. Tape:

1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.

2. Printing on tape shall be permanent and shall not be damaged by burial operations.

3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

4. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.

5. Overall Thickness: 5 mils (0.125 mm).

6. Foil Core Thickness: 0.35 mil (0.00889 mm).

7. Weight: 28 lb/1000 sq. ft. (13.7 kg/100 sq. m).

8. 3-Inch (75-mm) Tensile According to ASTM D 882: 70 lbf (311.3 N), and 4600 psi (31.7 MPa).

B. Color and Printing:

1. Comply with ANSI Z535.1 through ANSI Z535.5.

2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE,.

3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.

2.6 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

C. Baked-Enamel Warning Signs:

1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.

2. 1/4-inch (6.4-mm) grommets in corners for mounting.

3. Nominal size, 7 by 10 inches (180 by 250 mm).

D. Metal-Backed, Butyrate Warning Signs:

1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch (1-mm) galvanized-steel backing; and with colors, legend, and size required for application.

2. 1/4-inch (6.4-mm) grommets in corners for mounting.

3. Nominal size, 10 by 14 inches (250 by 360 mm).

E. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."

2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 48 INCHES (1200 MM)."

2.7 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq. inches (129 sq. cm) and 1/8 inch (3.2 mm) thick for larger sizes.

1. Engraved legend with black letters on white face.

2. Punched or drilled for mechanical fasteners.

3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

B. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm).

C. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm). Overlay shall provide a weatherproof and UV-resistant seal for label.

2.8 EQUIPMENT IDENTIFICATION LABELS

A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).

B. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch (25 mm).

2.9 CABLE TIES

A. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.

1. Minimum Width: 3/16 inch (5 mm).

2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 7000 psi (48.2 MPa).

3. UL 94 Flame Rating: 94V-0.

4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).

2.10 Color: Black. MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in Division 09 painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

F. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

G. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.

H. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:

1. Outdoors: UV-stabilized nylon.

2. In Spaces Handling Environmental Air: Plenum rated.

I. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches (400 mm) overall.

J. Painted Identification: Comply with requirements in Division 09 painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

A. Concealed Raceways, Duct Banks, More Than 600 V, within Buildings: Tape and stencil 4-inch- (100-mm-) wide black stripes on 10-inch (250-mm) centers over orange background that extends full length of raceway or duct and is 12 inches (300 mm) wide. Stencil legend "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch- (75-mm-) high black letters on 20-inch (500-mm) centers. Stop stripes at legends. Apply to the following finished surfaces:

1. Floor surface directly above conduits running beneath and within 12 inches (300 mm) of a floor that is in contact with earth or is framed above unexcavated space.

2. Wall surfaces directly external to raceways concealed within wall.

3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.

B. Accessible Raceways, Armored and Metal-Clad Cables, More Than 600 V: Snap-around labels. Install labels at 30-foot (10-m) maximum intervals.

C. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:

1. Emergency Power.

2. Power.

3. UPS.

D. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder and branch-circuit conductors. Color coding is based on clockwise rotation.

a. Conductors No. 6 AWG and below shall be color coded with colored insulation. Larger sizes may be identified by field-applied color-coding conductor tape.

b. Colors for 208/120-V Circuits:

1) Phase A: Black.

2) Phase B: Red.

3) Phase C: Blue.

4) Neutral: White.

5) Neutral A: White w/ Black Stripe.

6) Neutral B: White w/ Red Stripe.

7) Neutral C: White w/ Blue Stripe.

8) Ground: Green.

c. Colors for 480/277-V Circuits:

1) Phase A: Brown.

2) Phase B: Orange.

3) Phase C: Yellow.

4) Neutral: Grey.

5) Neutral A: Gray w/ Brown Stripe.

6) Neutral A: Gray w/ Orange Stripe.

7) Neutral A: Gray w/ Yellow Stripe.

8) Ground: Green.

d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

E. Power-Circuit Conductor Identification, More than 600 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use write-on tags.

1. For HV cable in each manhole or transformer vault via a permanently installed metal tag and colored tape. Tag cables with feeder number and identification at all visible points on phase B. Phasing will be consistent with the rest of the system and shall be marked as follows:

a. Phase 1: Black.

b. Phase 2: Red.

c. Phase 3: Blue.

F. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

G. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.

H. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.

2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.

3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.

I. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.

1. Install underground-line warning tape for both direct-buried cables and cables in raceway.

J. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and

29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

K. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.

1. Comply with 29 CFR 1910.145.

2. Identify system voltage with black letters on an orange background.

3. Apply to exterior of door, cover, or other access.

4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:

a. Power transfer switches.

b. Controls with external control power connections.

L. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

M. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer.

N. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:

a. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.

b. Outdoor Equipment: Engraved, laminated acrylic or melamine label stenciled legend 4 inches (100 mm) high.

c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.

d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

2. Equipment to Be Labeled:

a. Enclosures and electrical cabinets.

b. Access doors and panels for concealed electrical items.

c. Switchgear.

d. Switchboards.

e. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.

f. Substations.

g. Emergency system boxes and enclosures.

h. Enclosed switches.

i. Enclosed circuit breakers.

j. Push-button stations.

k. Power transfer equipment.

l. Contactors.

m. Monitoring and control equipment.

3.3 IDENTIFICATION REQUIREMENTS FOR MEDIUM-VOLTAGE INSTALLATIONS

A. Labeling & ID Tags

1. General Requirements

a. install appropriate labels and tags throughout the project's electrical system as directed by USU electric shop.

b. The purpose of the labels and tags is to provide clear indications of the function of each item, the loads served, routing information, etc., for primary and secondary elements comprising the electrical system.

2. Permanently Engraved Lamicoid Nameplates

a. Specify permanently engraved nameplates, labels, or ID tags for a master nameplate, also for manholes, distribution equipment, devices, etc.

b. Lamicoid nameplates shall be three-ply plastic, 1/16 inch thick. Letters shall be formed by engraving into the outer colored ply, exposing the white or black center-ply. Lettering shall be a minimum of 5/8 inch high, except for MV cable.

END OF SECTION 26 05 53

SECTION 26 0574

OVERCURRENT PROTECTIVE DEVICE AND ARC-FLASH STUDY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes a computer-based, arc-flash study to determine the arc-flash hazard distance and the incident energy to which personnel could be exposed during work on or near electrical equipment.

B. Section includes computer-based, overcurrent protective device coordination studies to determine overcurrent protective devices and to determine overcurrent protective device settings for selective tripping.

1. Study results shall be used to determine coordination of series-rated devices.

1.3 DEFINITIONS

A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

B. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

D. SCCR: Short-circuit current rating.

E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.4 ACTION SUBMITTALS

A. Product Data: For computer software program to be used for studies.

1. Coordination-study input data, including completed computer program input data sheets.

2. Study and equipment evaluation reports.

3. Overcurrent protective device coordination study report; signed, dated, and sealed by a qualified professional engineer.

4. Arc-flash study input data, including completed computer program input data sheets.

5. Arc-flash study report; signed, dated, and sealed by a qualified professional engineer.

a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment

manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

1) All studies shall be performed and reviewed prior to substantial completion for the project. Project substantial completion requires final approved submittal. All arc flash labels shall be permanently installed from arc flash study prior to substantial completion.

1.5 INFORMATIONAL SUBMITTALS

A. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance procedures according to requirements in NFPA 70E shall be provided in the equipment manuals.

B. Operation and Maintenance Procedures: In addition to items specified in Section 017823 "Operation and Maintenance Data," provide maintenance procedures for use by Owner's personnel that comply with requirements in NFPA 70E.

1. Include the following:

a. The following parts from the Protective Device Coordination Study Report:

1) SKM Model.

2) One-line diagram.

3) Protective device coordination study.

4) Time-current coordination curves.

b. Power system data.

1.7 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

B. Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

C. Study Specialist Qualifications: Professional engineer in charge of performing the study, analyzing the arc flash, and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

D. Field Adjusting Agency Qualifications: An independent agency, with the experience and capability to adjust overcurrent devices and to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

A. Software Developers: Subject to compliance with requirements, provide software by the following:

1. SKM Systems Analysis, Inc.

B. Comply with IEEE 1584 and NFPA 70E.

C. Comply with IEEE 242 and IEEE 399.

D. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

E. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.

1. Optional Features:

a. Arcing faults.

b. Simultaneous faults.

c. Explicit negative sequence.

d. Mutual coupling in zero sequence.

2.2 SHORT-CIRCUIT STUDY REPORT CONTENT

A. Executive summary.

B. Study descriptions, purpose, basis and scope.

C. One-line diagram, showing the following:

1. Protective device designations and ampere ratings.

2. Cable size and lengths.

3. Transformer kilovolt ampere (kVA) and voltage ratings.

4. Motor and generator designations and kVA ratings.

5. Switchgear, switchboard, motor-control center and panelboard designations.

D. Study Input Data: As described in "Power System Data" Article.

E. Short-Circuit Study Output:

1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

a. Voltage.

b. Calculated symmetrical fault-current magnitude and angle.

c. Fault-point X/R ratio.

d. No AC Decrement (NACD) ratio.

e. Equivalent impedance.

f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.

g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

F. Incident Energy and Flash Protection Boundary Calculations:

1. Arcing fault magnitude.

2. Protective device clearing time.

3. Duration of arc.

4. Arc-flash boundary.

5. Working distance.

6. Incident energy.

7. Hazard risk category.

8. Recommendations for arc-flash energy reduction.

G. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of the computer printout.

2.3 PROTECTIVE DEVICE COORDINATION STUDY REPORT CONTENTS

A. Executive summary.

B. Study descriptions, purpose, basis and scope. Include case descriptions, definition of terms and guide for interpretation of the computer printout.

C. One-line diagram, showing the following:

1. Protective device designations and ampere ratings.

2. Cable size and lengths.

3. Transformer kilovolt ampere (kVA) and voltage ratings.

4. Motor and generator designations and kVA ratings.

5. Switchgear, switchboard, motor-control center, and panelboard designations.

D. Study Input Data: As described in "Power System Data" Article.

E. Short-Circuit Study:

1. Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

a. Voltage.

b. Calculated fault-current magnitude and angle.

c. Fault-point X/R ratio.

d. Equivalent impedance.

2. Momentary Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

a. Voltage.

b. Calculated symmetrical fault-current magnitude and angle.

c. Fault-point X/R ratio.

d. Calculated asymmetrical fault currents:

1) Based on fault-point X/R ratio.

2) Based on calculated symmetrical value multiplied by 1.6.

3) Based on calculated symmetrical value multiplied by 2.7.

3. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

a. Voltage.

b. Calculated symmetrical fault-current magnitude and angle.

c. Fault-point X/R ratio.

d. No AC Decrement (NACD) ratio.

e. Equivalent impedance.

f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.

g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

F. Protective Device Coordination Study:

1. Report recommended settings of protective devices, ready to be applied in the field. Use manufacturer's data sheets for recording the recommended setting of overcurrent protective devices when available.

a. Phase and Ground Relays:

1) Device tag.

2) Relay current transformer ratio and tap, time dial, and instantaneous pickup value.

3) Recommendations on improved relaying systems, if applicable.

b. Circuit Breakers:

1) Adjustable pickups and time delays (long time, short time, ground).

2) Adjustable time-current characteristic.

3) Adjustable instantaneous pickup.

4) Recommendations on improved trip systems, if applicable.

c. Fuses: Show current rating, voltage, and class.

G. Time-Current Coordination Curves: Determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:

1. Device tag and title, one-line diagram with legend identifying the portion of the system covered.

2. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.

3. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.

4. Plot the following listed characteristic curves, as applicable:

a. Power utility's overcurrent protective device.

b. Medium-voltage equipment overcurrent relays.

c. Medium- and low-voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.

d. Low-voltage equipment circuit-breaker trip devices, including manufacturer's tolerance bands.

e. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.

f. Cables and conductors damage curves.

g. Ground-fault protective devices.

h. Motor-starting characteristics and motor damage points.

i. Generator short-circuit decrement curve and generator damage point.

j. The largest feeder circuit breaker in each motor-control center and panelboard.

5. Series rating on equipment allows the application of two series interrupting devices for a condition where the available fault current is greater than the interrupting rating of the downstream equipment. Both devices share in the interruption of the fault and selectivity is sacrificed at high fault levels. Maintain selectivity for tripping currents caused by overloads.

6. Provide adequate time margins between device characteristics such that selective operation is achieved.

7. Comments and recommendations for system improvements.

2.4 ARC-FLASH WARNING LABELS

A. Comply with requirements in Section 260553 "Identification for Electrical Systems." Produce a 3.5-by-5-inch (76-by-127-mm) thermal transfer label of high-adhesion polyester for each work location included in the analysis.

B. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:

1. Location designation.

2. Nominal voltage.

3. Flash protection boundary.

4. Hazard risk category.

5. Incident energy.

6. Working distance.

7. Engineering report number, revision number, and issue date.

C. Labels shall be machine printed, with no field-applied markings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.

3.2 SHORT-CIRCUIT STUDY

A. Perform study following the general study procedures contained in IEEE 399.

B. Calculate short-circuit currents according to IEEE 551.

C. Base study on the device characteristics supplied by device manufacturer.

D. The extent of the electrical power system to be studied is indicated on Drawings.

E. Begin analysis at the service, extending down to the system overcurrent protective devices as follows:

1. To normal system low-voltage load buses where fault current is 10 kA or less.

2. Exclude equipment rated 240-V ac or less and under 60A.

F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.

G. The calculations shall include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and shall apply to low- and medium-voltage, three-phase ac systems.

H. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and single line-to-ground fault at each of the following:

1. Electric utility's supply termination point.

2. Switchgear.

3. Unit substation primary and secondary terminals.

4. Low-voltage switchgear.

5. Motor-control centers.

6. Standby generators and automatic transfer switches.

7. Branch circuit panelboards.

3.3 PROTECTIVE DEVICE COORDINATION STUDY

A. Comply with IEEE 242 for calculating short-circuit currents and determining coordination time intervals.

B. Comply with IEEE 399 for general study procedures.

C. The study shall be based on the device characteristics supplied by device manufacturer.

D. The extent of the electrical power system to be studied is indicated on Drawings.

E. Begin analysis at the service, extending down to the system overcurrent protective devices as follows:

1. To normal system low-voltage load buses where fault current is 10 kA or less.

2. Exclude equipment rated 240-V ac or less and under 60A.

F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

G. Transformer Primary Overcurrent Protective Devices:

1. Device shall not operate in response to the following:

a. Inrush current when first energized.

b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.

c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.

2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.

H. Motor Protection:

1. Select protection for low-voltage motors according to IEEE 242 and NFPA 70.

2. Select protection for motors served at voltages more than 600 V according to IEEE 620.

I. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and protection recommendations in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

J. Generator Protection: Select protection according to manufacturer's written recommendations and to IEEE 242.

K. The calculations shall include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and shall apply to low- and medium-voltage, three-phase ac systems. The calculations shall also account for the fault-current dc decrement, to address the asymmetrical requirements of the interrupting equipment.

1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.

L. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and single line-to-ground fault at each of the following:

1. Electric utility's supply termination point.

2. Switchgear.

3. Unit substation primary and secondary terminals.

4. Low-voltage switchgear.

5. Motor-control centers.

6. Standby generators and automatic transfer switches.

7. Branch circuit panelboards.

M. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to short-circuit ratings.

2. Adequacy of switchgear, motor-control centers, and panelboard bus bars to withstand short-circuit stresses.

3. Any application of series-rated devices shall be recertified, complying with requirements in NFPA 70.

3.4 LOAD-FLOW AND VOLTAGE-DROP STUDY

A. Perform a load-flow and voltage-drop study to determine the steady-state loading profile of the system. Analyze power system performance two times as follows:

1. Determine load-flow and voltage drop based on full-load currents obtained in "Power System Data" Article.

2. Determine load-flow and voltage drop based on 80 percent of the design capacity of the load buses.

3. Prepare the load-flow and voltage-drop analysis and report to show power system components that are overloaded, or might become overloaded; show bus voltages that are less than as prescribed by NFPA 70.

3.5 POWER SYSTEM DATA

A. Obtain all data necessary for the analysis.

1. Verify completeness of data supplied on the one-line diagram on Drawings. Call discrepancies to the attention of Architect.

2. For new equipment, use characteristics submitted under the provisions of action submittals and information submittals for this Project.

3. For existing equipment, whether or not relocated, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers.

B. Gather and tabulate the following input data to support coordination study. Comply with recommendations in IEEE 1584, IEEE 241, IEEE 551, and NFPA 70E as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.

1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.

2. Obtain electrical power utility impedance at the service.

3. Power sources and ties.

4. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in per cent, and phase shift.

5. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.

6. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.

7. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.

8. Motor horsepower and NEMA MG 1 code letter designation.

9. Low-voltage cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).

10. Short-circuit current at each system bus, three phase and line-to-ground.

11. Full-load current of all loads.

12. Voltage level at each bus.

13. Maximum demands from service meters.

14. Medium-voltage cable sizes, lengths, conductor material, and cable construction and metallic shield performance parameters.

15. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:

    a. Special load considerations, including starting inrush currents and frequent starting and stopping.

    b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.

    c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.

    d. Generator thermal-damage curve.

    e. Ratings, types, and settings of utility company's overcurrent protective devices.

    f. Special overcurrent protective device settings or types stipulated by utility company.

    g. Time-current-characteristic curves of devices indicated to be coordinated.

    h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.

    i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.

    j. Panelboards, switchboards, motor-control center ampacity, and SCCR in amperes rms symmetrical.

    k. Identify series-rated interrupting devices for a condition where the available fault current is greater than the interrupting rating of the downstream equipment.

Obtain device data details to allow verification that series application of these devices complies with NFPA 70 and UL 489 requirements.

3.6 FIELD ADJUSTING

A. Adjust relay and protective device settings according to the recommended settings provided by the coordination study. Field adjustments shall be completed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.

B. Make minor modifications to equipment as required to accomplish compliance with short-circuit and protective device coordination studies.

C. Testing and adjusting shall be by a full-time employee of the Field Adjusting Agency, who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters. Perform NETA tests and inspections for all adjustable overcurrent protective devices.

3.7 ARC-FLASH HAZARD ANALYSIS

A. Comply with NFPA 70E and its Annex D for hazard analysis study.

B. Use the short-circuit study output and the field-verified settings of the overcurrent devices.

C. Calculate maximum and minimum contributions of fault-current size.

1. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume no motor load.

2. The maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.

D. Calculate the arc-flash protection boundary and incident energy at locations in the electrical distribution system where personnel could perform work on energized parts.

E. Include medium- and low-voltage equipment locations, except 240-V ac and 208-V ac systems below 60A.

F. Safe working distances shall be specified for calculated fault locations based on the calculated arc-flash boundary, considering incident energy of 1.2 cal/sq.cm.

G. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented as follows:

1. Fault contribution from induction motors should not be considered beyond three to five cycles.

2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g., contributions from permanent magnet generators will typically decay from 10 per unit to three per unit after 10 cycles).

H. Arc-flash computation shall include both line and load side of a circuit breaker as follows:

1. When the circuit breaker is in a separate enclosure.

2. When the line terminals of the circuit breaker are separate from the work location.

I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

3.8 LABELING

A. Apply one arc-flash label for 600-V ac, 480-V ac, and applicable 208-V ac panelboards and disconnects and for each of the following locations:

1. Motor-control center.

2. Low-voltage switchboard.

3. Switchgear.

4. Medium-voltage switch.

5. Control panel.

6. Mechanical Equipment over 100A.

3.9 APPLICATION OF WARNING LABELS

A. Install the arc-fault warning labels under the direct supervision and control of the Arc-Flash Study Specialist.

3.10 DEMONSTRATION

A. Contractor shall train Owner's maintenance personnel in the potential arc-flash hazards associated with working on energized equipment and the significance of the arc-flash warning labels.

B. Contractor shall train Owner's maintenance personnel in the following:

1. Acquaint personnel in the fundamentals of operating the power system in normal and emergency modes.

2. Hand-out and explain the objectives of the coordination study, study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpreting the time-current coordination curves.

3. Adjust, operate, and maintain overcurrent protective device settings.

END OF SECTION 26 05 74

SECTION 26 0800

ELECTRICAL SYSTEMS COMMISSIONING

PART 1 – GENERAL REQUIREMENTS

1.1 RELATED WORK

A Specification Section 019113 – “General Commissioning Requirements”
B Specification Section 230800 – “HVAC Systems Commissioning
C Specification Section 220800 – “Plumbing Systems Commissioning”

1.2 Description

A. The purpose of the commissioning process is to provide the Owner/operator of the facility with a high level of assurance that the electrical and associated electrical Systems have been installed in the prescribed manner, and operate within the performance guidelines set in the design intent. The Commissioning Authority shall provide the Owner with an unbiased, objective view of the systems installation, operation, and performance. This process is not to take away or reduce the responsibility of the design professionals or installing contractors to provide a finished product. Commissioning is intended to enhance the quality of system start-up and aid in the orderly transfer of systems to beneficial use by the owner. The Commissioning Authority will be a member of the construction team, cooperating and coordinating all commissioning activities with the design professionals, construction manager, contractors, subcontractors, manufacturers and equipment suppliers.

1.3 Scope

A The electrical systems commissioning shall include a demonstration by the Contractor with the assistance of the Commissioning Authority (CxA) of each piece of equipment to comply with the Owners Project Requirements (OPR) and the Construction Documents (CD). The commissioning process shall demonstrate that each piece of equipment is performing and operating to the OPR and CDs.

B Participants in Electrical Systems Commissioning: Electrical systems shall be conducted with representatives from the following entities (the required participants shall be confirmed with the commissioning agent prior to scheduling the commissioning).

1. General Contractor
2. Owners Representative
3. Electrical Contractor
4. Fire Alarm Contractor

C Major Pieces of Equipment shall be defined as: (While this list is meant to show a representative sample any equipment that uses electrical energy)

1. Network Lighting Controls
2. UPS Systems
3. Coordination Study

4. Generators
5. Automatic Transfer Systems
6. Metering Devices

D Kickoff, Coordination and MEP Meetings

1. Bi-weekly meetings shall be held by the CxA with full participation and attendance of all participants as indicated in the “Participants in Electrical Systems Commissioning” section.
2. These meetings will be held at the CxA convenience and shall be scheduled on a regular basis.
3. Other meetings such as the Commissioning Kick-Off Meeting, Update Meetings, Controls Meeting, Submittal Meetings and other Coordination Meetings shall be attended by those participants as indicated in the “Participants in Electrical Systems Commissioning”

E Submittal Reviews and Meetings

4. The CxA shall review each submittal in Division 26. The contractor shall look and ask for the CxA comments if the comments are not in the return submittal. It is the sole responsibility of the contractor to search out and ask for the CxA comments.
5. For major pieces of equipment, the contractor, sub-contractors, and suppliers shall be in attendance for a submittal review meeting with the Owner and CxA to review the submittal with the Owner and CxA and address any deficiencies.
6. Submittal reviews are NOT an approval but a courtesy review to help validate products submitted is in general compliance with the construction documents. It is the suppliers and contractor’s responsibility to verify the supplied product meets or exceeds the construction documents requirements or the supplier is to provide a separate letter noting each of the requirements that has not been achieved and MUST identify they are not in compliance with the construction documents and request a PR. Failure to do so may require modification or replacement of the product when onsite or installed

F Issues Log

1. An issues log shall be kept by the CxA. These issues will intensify issues, defects, improper installations, and deficiencies of the installation and design. The issues log will have the issue, a potential resolution, the sub-contractor responsible, the date of the issue found and the CxA who found the issue.
2. The issues log shall be immediately addressed every week by the contractor. If an issue lags beyond four (4) weeks, the CxA shall request from the Owner and reduction in payment for services by the contractor.
3. When an item is completed and addressed by the contractor or sub-contractor responsible, the party responsible shall sign off and deliver to the CxA for review. The sign off shall include how the contractor addressed the issue and the date in which the contractor addressed the issue. If the issue has not been addressed after re-inspection the contractor shall be liable for the CxA time and efforts as outlined later in this specification.

G Construction Checklist, Pre and Final Functional Testing Checklist, and Startup Checklist

1. The CxA shall develop construction checklist that will be executed by the CxA. The contractors and sub-contractors shall review the checklist for compliance with the ability of their individual systems. If the contractor or sub-contractors do not provide comments to the CxA then the CxA shall assume their procedures shall not harm nor deteriorate the individual systems. If a problem occurs during testing that causes a piece of equipment of system to malfunction, damage, or any other failure and the contractor or sub-contractor has not in writing opposed such test then the contractor or sub-contractor shall be liable for any damages and delays.
2. The contractor shall fill out checklist called Contractor Readiness checklist. These shall be delivered in the commissioning plan and shall be used to show the CxA that the contractor is ready for Final Function Testing.
3. Startup Sheets shall be delivered to the CxA. The contractor responsible for the piece of equipment is also responsible for delivering those startup sheets to the CxA.
4. Functional Testing shall be attended by the members as defined in “Participants in Electrical Systems Commissioning.”
5. Should any of the aforementioned requirements not be met on the date that the commissioning process commences and or if deficiencies are observed during the commissioning process the commissioning will be considered a failure and the deficiencies will be required to be remedied and then addressed in writing prior to requesting a date for re-commissioning. There will be no additional costs allowed to the Contractor for re-commissioning sessions as may be required to address issues that are found to be in non-compliance with the requirements of this specification. The contractor shall be responsible for the CxA additional time due to absence of the member as outlined later in this specification.

H Current Facility Requirements and Operations and Maintenance Document

1. The contractors and sub-contractors shall prepare a documents that contains the following pieces of information. This document shall include the following:

    a. Set points for network lighting controls and building schedules
    b. Set points for Daylighting and Occupancy Sensors
    c. Set lighting levels throughout the building
    d. Any changes in schedules or set points for different seasons, days of the week, and times of day
    e. A systems narrative describing the electrical systems and equipment
    f. a·preventive·maintenance·plan·for·electrical·equipment·described·in·the·systems·narrative
    g. final installed settings of all adjustable overload protective devices

2. The document shall be delivered to the CxA by the contractor in a Microsoft Word (.doc or .docx) format

I Systems Manual

1. The contractors and sub-contractors shall prepare a documents that contains the following pieces of information. This document shall include the following:

a. Construction record documents and specifications
b. Approved submittals
c. As-built drawings
d. As-built sequence of operation for network lighting controls
e. Recommended schedule for sensor recalibration
f. Equipment operations and maintenance manuals
g. Equipment preventive maintenance schedules
h. Confirmation of completed training for the owner and occupants

J Sky Spark Implementation

1. SkySpark, by Sky Foundry, shall be implemented on this project. The Lighting Controls (booth local, i.e. occupancy sensors daylighting sensors, and network) contractor shall furnish their expertise and time to help with point assignments, communication, and network setup.
2. The Lighting Controls contractor shall spend 40 hours to help implement this process. The Lighting Controls contractor shall furnish an integration specialist to assist with this setup for the 40 hours, a salesperson or representative without knowledge of the project shall not be considered as a specialist.
3. The CxA or a representative appointed by the CxA shall work with the controls contractor, any issues with the Lighting Controls failure to communicate shall not go against the 40 hours.

K Access to Network Lighting Controls System Software

1. The Lighting Controls contractor shall give the CxA their own password and user name for their system.
2. The contractor shall also give Admin Access to the CxA to change settings, review programming, and review settings.

1.4 SYSTEMS TO BE COMMISSIONED

A. This list is not intended to be exhaustive. All division 22 and 23 and any equipment, piping, balancing, controls, etc. that are defined in the entire cumulative sections of division 22 and 23 will go through commissioning. The below list is a representative sample of items that are typically commissioned.

1. Network Lighting Controls
2. Occupancy/Vacancy Sensors
3. Daylighting/Photocell Systems
4. UPS Systems
5. Cable Trays
6. Fire Alarm Systems
7. Overload Protected Devices
8. Coordination Study
9. Generators
10. Automatic Transfer Systems
11. Panelboards
12. Lighting

13. Local Lighting Controls
14. Receptacles
15. Motor Control Centers
16. Transformers
17. Medium Voltage Cabling
18. Raceways
19. Switchgear
20. Main Distribution Boards
21. Switchboards
22. Variable Frequency Drives
23. Medium Voltage Switchgear
24. Metering Devices
25. Surge Protection Systems
26. Power Factor Correction
27. Electrical Distribution
28. Motor Starters
29. Disconnects
30. Hand-Off-Autos

1.5 COORDINATION

A The Commissioning authority shall receive a copy of all construction documents, addenda, change orders, and appropriate approved submittals and shop drawings directly from the Contractor.

B The Commissioning Authority shall disseminate written information and documents to all responsible parties relative to the nature and extent of the communication.

C The Commissioning Authority is primarily responsible to the Owner, and as such, shall regularly appraise the Architect, the Contractor, and the Owner of progress, pending problems and/or disputes, and shall provide regular status reports on progress with each system. Any potential change in the contractual and/or financial obligations of the owner (credits, change orders, schedule changes, etc.) shall be identified and quantified as soon as possible.

D The Commissioning Authority shall coordinate the schedule of commissioning activities with the construction schedule. It is possible that some procedures will be completed before the entire Electrical system is completed.

1.6 SCHEDULE

A Final Commissioning shall not commence on the individual pieces of equipment, Network Lighting Controls, Occupancy and Daylighting Sensors and d other electrical systems until the Contractor Readiness Forms are delivered to the CxA.

B Pre-Functional Commissioning shall commence during the progress of the project. Contractor Readiness checklist do not typically have to be filled out for the CxA to check out these systems. However, the contractor is responsible to inform and schedule the CxA to do Pre-Functional Checks.

C Contractor schedules and scheduling is the responsibility of the Contractor. The Commissioning Authority shall provide commissioning scheduling information to the contractor for review and planning activities.

D The following list is a general set of tasks and criteria along with an approximate duration for each task in regards to the CxA activities. This list is intended to be utilized as a guideline for creating an appropriate schedule for all of the work related to electrical systems commissioning. Three of these activities can be commissioned concurrently at one time. These activities do not include the PFAT Systems. The activities do not include issues that will take additional days to fix.

1. PFAT Systems – PFATs will be completed within 10 business days of the contractor native to CxA to start. We expect these systems to be split up and not told to inspect ALL systems at one time. These will be completed during the typical construction schedule and before Startup.
2. Variable Frequency Drives – 3 business days
3. Network Lighting Controls – 10 business days
4. Occupancy Sensors/Daylighting Sensors – 10 business days
5. Panelboards – 3 business days
6. Receptacles – 7 business days
7. Lighting and Local Lighting Controls – 7 business days
8. Metering – 2 business days
9. Fire Alarm Review – 2 business days

E Most other electrical systems are covered during PFAT phase or HVAC Systems Commissioning and the electrical systems associated with those systems shall be commissioned with the HVAC Systems Commissioning.

F Completion and acceptance of the electrical systems commissioning shall be a condition of Substantial Completion. The building shall be considered 'not ready to utilize for its intended use' until such time that the electrical systems commissioning is successfully completed.

1. In the event that Substantial Completion is given by the owner to the Contractor and Commissioning is not complete then the Warranty period for all pieces of electrical systems shall not begin until the CxA gives their final Commissioning Report.

1.7 Miscellaneous Contractor Responsibilities

A Means and Methods: The contractor is solely responsible for the means and methods of construction. While the CxA shall assist in construction the final responsibility rest solely on the General and Installation Contractor.

B Special Tools and Equipment: While the CxA retains tools in accordance with NEBB BSC Procedural Standards any specialized tools to test the equipment shall be provided to the CxA and used by the Contractor to prove compliance with the OPR and Construction Documents.

PART 2 – PRODUCTS

(NOT USED)

PART 3 – EXECUTION

3.1 commissioning Kickoff meeting

A The CxA shall facilitate a Commissioning Kickoff Meeting after all Electrical, Electrical, and Plumbing subcontractors are under contract with the General Contractor. The CxA shall invite the Architect, Engineers, and Owners Representatives to the meeting.

B The General Contractor shall ensure that the following individuals are in attendance:

2. The Electrical Foreman and Project Manager
3. The Plumbing Foreman and Project Manager
4. The Controls Foreman and Project Manager
5. The Test and Balance Project Manager
6. The Electrical Foreman and Project Manager
7. The Fire Protection Foreman and Project Manager
8. The General Contractor Project Engineer, Superintendent, and Project Manager

C The CxA shall keep meeting minutes and distribute to the individuals present.

3.2 Distribution List

A. The distribution list shall be developed during the Commissioning Kickoff Meeting. This distribution list shall be used for all distribution of commissioning activities. While every effort shall be made to distribute all pertinent information to the sub-contractors by the CxA, the sole responsibility for sub-contractors to receive information rest on the General Contractor.

B If the sub-contractors do not receive information in regards to commissioning activities and the CxA has to reschedule a meeting or appointment or testing activity the contractor shall reimburse the CxA for any expenses as a result.

3.3 Commissioning Plan

A. The Commissioning Plan shall be developed by the CxA and delivered at the conclusion of the submittal process.

B The Commissioning Plan will have the CxA Procedural Standards for testing, the PFAT checklist, the FAT checklist and the Contractor Readiness checklist.

C The sub-contractors and contractors are responsible for reviewing the above checklist and provide comments to the CxA within 30 calendar days of receiving the commissioning plan. During this comment period the comments must be received in writing and the CxA will work with the individual contractors and sub-contractors to ensure the safety of systems. After the 30-day period for comment any additional comments received shall be reviewed by the CxA, however, the subcontractor shall be liable for any cost associated with this review and any delays.

3.4 Submittal Reviews and Submittal Meetings

A The CxA shall review all electrical submittals. It is the responsibility of the contractor to ensure they receive the CxA reviews. The Architect is responsible for delivering the submittals to the CxA, however, in the return submittal if the contractor does not see our review or see an acknowledgement that we did not want to review the submittal it is the responsibility of the contractor to ask for the submittal from the CxA directly.

B The subcontractor, supplier and manufacturer are responsible to submit with initial submittals a line by line submittal compliance document. The compliance document will follow the specification that the submittal is in reference too. The compliance document will have one of the following for each paragraph of the specification: Comply, Exception, or Unable to Comply. With each Exception and Unable to Comply the compliance document will have a detailed explanation.

C The subcontractor, supplier and manufacturer shall attend a submittal review meeting before any piece of equipment shall be ordered. This meeting will be held and conducted by the Commissioning Authority at a place designated by Commissioning Authority (which typically is the General Contractors Trailer). During this meeting the CxA, Engineer, and Owner will review the submittal compliance document.

D The submittals will be marked with Reviewed, reviewed as Noted, defer to Engineer, Note, or Revise and Resubmit. Only Revise and Resubmit items will have the expectation of a re-submittal. In the event that any item is marked as Revise and Resubmit contractor shall pay all expenses incurred by the CX Authority for the re-review process.

3.5 Building Information Modeling (BIM) Reviews

A. The CxA shall review the BIM models at 90% completion for access issues. The file shall be delivered to the CxA in a NavisWorks format (.nwd).

B The contractor may split the review up by floors. Partial floors shall not be reviewed by the CxA until the entire floor is completed to 90%.

C The CxA shall deliver a floor plan with markups on areas of access concern.

D The BIM model shall include all items as outlined in specification 019113 – “General Commissioning Requirements”

3.6 Coordination Meetings (MEP Meetings)

A. The CxA shall conduct a weekly coordination meeting. The electrical, plumbing, test and balance, electrical, and controls contractor shall attend these meetings on a weekly basis.

B The purpose of these meetings is to coordinate installation, commissioning, and testing activities. These meetings will be conducted by the CxA and minutes from these meetings shall be delivered to those individuals described in the Distribution List section.

3.7 Construction Observation and First Installs

A. The CxA shall observe construction activities throughout the construction of the project. The contractors shall be available during these observations for information. An issues log as outlined in Part 1 shall be kept by the CxA.

B First installs are not mockups; they are first installations of individual pieces of equipment that need to be installed in their location. First installs shall be required by the contractor and subcontractor for the following items:

1. Underground Raceway Installation
2. Aboveground Raceway Installation
3. Floor Boxes
4. Panelboards

C Contractor shall coordinate and not prohibit observations and first installs. Sub-contractors, owner's representatives and engineers shall review the first installs for compliance.

3.8 Contractor Readiness Checklist

A Contractor Readiness Checklist (CRC) shall be delivered by the CxA to the contracting team for the contracting team to fill out. The purpose of the CRCs to inform the CxA of the readiness of the contractor to begin Functional Testing on the electrical system.

B The CxA shall not begin Functional Testing of the system or any equipment until the CRC are received. While some systems can be tested without a complete system the CxA shall have the final say on which can and cannot begin functional testing based on the completeness of the project.

C If the contractor delivers the CRC and the CxA finds the system is not functional then the contractor shall be liable for cost incurred by the CxA.

3.9 Pre Functional Checklist

A The Pre Functional Checklist shall be developed by the CxA and delivered in the commissioning plan.

B The Pre Functional Checklist shall be reviewed by the contractors and sub-contractors and shall be executed by the CxA.

C The CxA shall review 100% of all electrical systems installations.

3.10 Functional Performance Checklist

A The CxA shall execute Functional Performance Checks with the attendance of suppliers, Electrical Contractors, Lighting Controls Contractor and the Fire Alarm Contractor at the request of the CxA.

B Commissioning Authority shall develop and document the commissioning procedures to be used this will be delivered to the contractor in the commissioning plan and is called the Procedural Standards. Include a performance checklist and performance test data sheets for each system

based on actual system configuration. These procedures shall be reviewed by the appropriate contractors and sub-contractors for technical depth, clarity of documentation and completeness. Emphasis shall be placed on testing procedures that shall determine actual system performance and compliance with the design intent.

C The Commissioning Authority shall determine the acceptance procedures for each system within electrical divisions as required. The acceptance procedures shall incorporate the commissioning standards and successful testing results as referred to throughout electrical and electrical specifications.

1. In particular, lighting controls systems including the network lighting controls, occupancy sensors, and daylighting controls.
2. Where NETA is required for test procedures in the other sections, whether the section requires a written test report or not, the electrical contractor shall provide a written report in accordance and outlined to the most current NETA specifications.

D The appropriate contractor and vendor(s) shall be informed of what tests are to be performed and the expected results. Whereas some test results and interpretations may not become evident until the actual tests are performed, all parties shall have a reasonable understanding of the requirements. The Commissioning Plan shall address those requirements and be distributed to all parties involved with that particular system.

E Acceptance procedures shall confirm the performance of systems to the extent of the design intent. When a system is accepted, the Owner shall be assured that the system is complete, works as intended, is correctly documented, and operator training has been performed.

F During the functional performance testing the BMS or ATC contractor shall be in attendance to setup the CxA on the controls system and be in attendance throughout the Sequence of Operation checks.

G The CxA shall review 100% and test 100% of electrical systems as outlined in the systems to be commissioned section.

3.11 Trending

A Trending points shall be outlined in the Procedural Standards as delivered by the CxA in the commissioning plan.

B The network lighting controls contractor shall trend the system in their software for a minimum of four (4) weeks. If the contractor is unable to do four weeks of trending in the system, then the contractor shall reimburse the Owner for CxA expenses to install temporary trending loggers.

3.12 Operation and Maintenance Manuals

A The contractor responsible for Electrical O&Ms shall deliver electronic copies of those O&M to the CxA at 50% billable completion of installed electrical systems. The O&M manuals shall include installation requirements and maintenance requirements.

1. The 50% electrical billable draw shall be held up by the owner at the request of the CxA if the O&M Manuals are not delivered.

B The final O&M Manual shall be reviewed by the CxA before delivery to the Owner. Any deficiencies shall be noted and the contractor shall remedy before final delivery.

C The final O&M must be delivered to the Owner before training shall commence and it shall be one of the requirements for Substantial Completion.

3.13 Current Facility Requirements and Operation and Maintenance Plan

A All contractors as defined in Participants in ELECTRICAL Commissioning shall compile a Current Facility Requirements (CFR) and Operations and Maintenance (O&M) Plan as outlined in LEED v4 EA – “Fundamental Commissioning and Verification”.

B The contractors shall provide the following in an editable Microsoft Word Format. (.doc or .docx) in a narrative format for use by the CxA to provide the final CFR and O&M Plan.

1. Building occupancy schedule
2. Set points for all lighting controls equipment
3. Lighting levels throughout the building
4. Changes in schedules or set points for different seasons, days of the week, and times of day
5. Systems narrative describing the electrical systems and equipment
6. Preventive maintenance plan for building equipment described in the systems narrative

3.14 Systems Manual

A All contractors as defined in Participants in ELECTRICAL Commissioning shall compile a Systems Manual.

B The contractors shall provide the following in an editable Microsoft Word Format. (.doc or .docx) in a narrative format for use by the CxA to provide the final Systems Manual. The submittals shall be compiled by section in a .pdf format.

1. Construction record documents and specifications
2. Approved submittals
3. As-built drawings
4. As-built sequence of operation
5. Original set points for all systems commissioned
6. Recommended schedule for sensor recalibration
7. Equipment operations and maintenance manuals
8. Equipment preventive maintenance schedules
9. Confirmation of completed training for the owner and occupants

3.15 TRAINING

A The CxA shall be invited to all electrical training sessions by the General Contractor.

B The training shall not commence until the system has been commissioned and proven ready for training.

C The contractor shall schedule and coordinate training sessions for the Owner's staff for each system. Training shall be in a classroom setting with the appropriate schematics, handouts, and visual/audio training aids on-site with equipment.

D The Commissioning Authority shall review agendas, which shall be submitted at least four weeks before training, and shall audit the training sessions. The agenda shall include but not limited to operational set points, runtime schedules, general operation and maintenance requirements, time and location for the training. Agendas shall conform to the Syllabus section in ASHRAE 0-2013-Appendix P and LEED v4 – EA – "Enhanced Commissioning".

E The training program shall include the following:

1. Emergency instructions and procedures
2. Operation instructions and procedures
3. Troubleshooting procedures
4. Maintenance and inspection procedures
5. Repair procedures
6. Upkeep of the systems manual and associated maintenance documentation logs

F Evaluations shall be done of the training system by the attendees. The evaluations shall reflect ASHRAE 0-2013-Appenix P Evaluation Form.

1. If the Evaluations from the training average rises above 2 (based on 1 being very well trained and 5 not at all trained) then the training shall recommence. All cost for the re-training shall be solely born by the contractor training including any reimbursement to the Owner for the CxA, the Owners Operational Staff, and any other cost born by the owner for failure to comply with requirements.

G The contractor shall provide a schedule for training times and dates. The schedule shall include location, who is training, trainers contact information,

H The appropriate installing contractors shall provide training on all the major systems per specifications, including peculiarities specific to this project.

I The equipment vendors shall provide training on the specifics of each major equipment item including philosophy, troubleshooting, and repair techniques.

J The automatic control vendor shall provide training on the control system per their specification section.

K The contractor shall furnish a final video DVD set, above the owner's requirements as defined elsewhere, to the CxA for their use and ownership and review. Included in those DVDs shall be the sign-in sheet for each training.

3.16 Record Drawings or Redlines

A The CxA shall review the "Redlines" or "Record Drawings" on a bi-weekly basis. Updating redlines shall be a term of a monthly draw and can hold up a monthly draw if the Record Drawings are not updated.

B Record Drawings or Redlines shall be kept in a printed format above and beyond any BIM modeling. If record drawings are being kept on BIM a printed out version on a typical 2D flat sheet of paper large enough to read shall be kept as well in the General Contractors trailer.

C The following requirements shall be meet for Redlines or Record Drawings:

1. Underground: All underground raceways 1.5" and larger or raceways accumulating in 1.5" or larger shall be shown with dimensions from walls (not gridlines) and elevations of the pipe at every ninety or y fitting and marked at every 20 feet on the drawings.
2. Above Ground Concealed: All above ground piping 1.5" and larger or raceways accumulating in 1.5" or larger concealed in hard lid or behind walls shall be dimensioned from walls.
3. Above Ground Accessible or Unconcealed: All above ground piping 1.5" and larger or raceways accumulating in 1.5" or larger shall be documented in the redlines. General location shall be sufficient as long as the general location is in the same area not separated by walls.

D The final redlines shall be reviewed by the CxA before delivery to the Architect.

3.17 Warranty Period and Continuous Commissioning

A The CxA shall provide Continuous Commissioning during the One Year Warranty Period after substantial completion. During this time the CxA shall adjust settings on the BMS for optimization of the system, shall find issues with the system, and shall report issues to the contractors.

B The contractor and sub-contractors shall resolve issues immediately.

3.18 Repeated Work, Testing, and Reviews

A Contractor shall, at no additional cost to the Owner, repeat the complete verification test procedure for each test for which acceptable results are not achieved. Repeat tests until acceptable results are achieved.

B Contractor shall compensate the Owner for costs incurred as the result of tests review or inspection repeated. This includes the costs for the Commissioning Authority, Design Architect, Design Engineers, and Owner--s personnel for billed costs (including travel expenses) for the extraordi-

nary participation of the Owners Representative, Architect, Commissioning Authority or owners staff.

C All retesting, inspection or review of equipment or re reviewing of startup sheets or re reviewing of electrical systems or re-reviewing of submittals shall be billed at an hour of $250 per hour with a minimum of 4 hours billed per session.

END OF SECTION 26 0800

SECTION 26 08 00
COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. This section includes specific requirements that apply to the implementation of the Commissioning Process and this Division Contractors' participation in this process. This section details the project specific equipment and systems that are included in the Commissioning Process. For general descriptions and responsibilities, refer to SECTION 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

1.02 RELATED DOCUMENTS

A. The Owner's Project Requirements (OPR) document.

B. The Basis of Design (BoD) document.

C. The Project Commissioning Plan (CxP) document.

D. ASHRAE Standard 202-2013 - Commissioning Process for Buildings and Systems.

E. LEED v4 for Building Design and Construction.

1.03 RELATED SECTIONS

A. SECTION 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS

B. SECTION 07 08 00 - COMMISSIONING OF THERMAL AND MOISTURE PROTECTION

C. SECTION 08 08 00 - COMMISSIONING OF OPENINGS

D. SECTION 11 08 00 - COMMISSIONING OF EQUIPMENT

E. SECTION 13 08 00 - COMMISSIONING OF SPECIAL CONSTRUCTION

F. SECTION 14 08 00 - COMMISSIONING OF CONVEYING SYSTEMS

G. SECTION 21 08 00 - COMMISSIONING OF FIRE SUPPRESSION SYSTEMS

H. SECTION 22 08 00 - COMMISSIONING OF PLUMBING SYSTEMS

I. SECTION 23 08 00 - COMMISSIONING OF MECHANICAL SYSTEMS

J. SECTION 25 08 00 - COMMISSIONING OF INTEGRATED AUTOMATION SYSTEMS

K. SECTION 27 08 00 - COMMISSIONING OF COMMUNICATIONS SYSTEMS

L. SECTION 28 08 00 - COMMISSIONING OF SAFETY AND SECURITY SYSTEMS

M. SECTION 33 08 00 - COMMISSIONING OF UTILITIES

1.04 DEFINITIONS

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

1.05 RESPONSIBILITIES

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

PART 2 PRODUCTS

2.01 NO PRODUCTS SUPPLIED

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

B. Contractors and/or Vendors shall provide the specialty testing equipment necessary to fulfill the functional testing requirements, for the duration of the testing period.

PART 3 EXECUTION

3.01 GENERAL

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.02 MEETINGS

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.03 SYSTEM START-UP

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.04 PRE-FUNCTIONAL CHECKLISTS

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.05 FUNCTIONAL PERFORMANCE TESTING

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.06 TRAINING

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.07 SYSTEMS TO BE COMMISSIONED

A. GENERAL
   1. Commissioning specifications supplement the requirements of individual specifications sections but shall not be interpreted to replace or diminish the specified scope of any individual section.
   2. For all systems listed below, Division Contractor shall comply with all commissioning requirements specified.

B. APPLICABLE SYSTEMS
   1. Grounding and Bonding for Electrical Systems
   2. Cable Trays for Electrical Systems
   3. Underfloor Ducts
   4. Vibration and Seismic Controls for Electrical Systems
   5. Identification for Electrical Systems
   6. Electrical Utility Services
   7. Integrated Low Voltage Distribution & Controls
   8. Digital Lighting Control System
   9. Digital Power Monitoring System
   10. Interior Lighting
   11. Exterior Lighting

END OF SECTION

SECTION 26 0923

DISTRIBUTED DIGITAL LIGHTING CONTROL SYSTEMS

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. Digital Lighting Load Controls
2. Relay Panels
3. Emergency Lighting Control (if applicable)

B. Related Sections:

1. Section 262726 - Wiring Devices Receptacles
2. Section 265113 – Interior Lighting Fixtures, Lamps, and Ballasts Fluorescent electronic dimming ballasts.

C. Control Intent – Control Intent includes, but is not limited to:

1. Defaults and initial calibration settings for such items as time delay, sensitivity, fade rates, etc.
2. Initial sensor and switching zones
3. Initial time switch settings
4. Emergency Lighting control (if applicable)

1.2 REFERENCES

A. American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE) (www.ansi.org and www.ieee.org)

B. International Electrotechnical Commission (IEC) (www.iec.ch)

C. International Organization for Standardization (ISO) (www.iso.ch):

D. National Electrical Manufacturers Association (NEMA) (www.nema.org)

E. WD1 (R2005) - General Color Requirements for Wiring Devices.

F. Underwriters Laboratories, Inc. (UL) (www.ul.com):

1. 508 – Industrial Controls
2. 916 – Energy Management Equipment
3. 924 – Emergency Lighting

G. Underwriter Laboratories of Canada (ULC) (www.ulc.ca)

1.3 SYSTEM DESCRIPTION & OPERATION

A. The Lighting Control and Automation system as defined under this section covers the following equipment:

1. Digital Lighting Management (DLM) local network – Free topology, plug-in wiring system (Cat 5e) for power and data to room devices.

2. Digital Room Controllers – Self-configuring, digitally addressable one, two or three relay plenum-rated controllers for on/off control. Selected models include 0-10 volt or line voltage forward phase control dimming outputs and integral current monitoring capabilities.

3. Digital Fixture Controllers – Self-configuring, digitally addressable one relay fixture-integrated controllers for on/off/0-10V dimming control.

4. Digital Occupancy Sensors – Self-configuring, digitally addressable, calibrated occupancy sensors with LCD display and two-way active infrared (IR) communications.

5. Digital Switches – Self-configuring, digitally addressable pushbutton on/off, dimming, and scene switches with two-way active infrared (IR) communications.

6. Handheld remotes for personal control – On/Off, dimming and scene remotes for control using infrared (IR) communications. Remote may be configured in the field to control selected loads or scenes without special tools.

7. Digital Daylighting Sensors – Single-zone closed loop, multi-zone open loop and single-zone dual-loop daylighting sensors with two-way active infrared (IR) communications for daylight harvesting using switching, bi-level, tri-level or dimming control.

8. Configuration Tools – Handheld remote for room configuration and relay panel programming provides two way infrared (IR) communications to digital devices and allows complete configuration and reconfiguration of the device / room from up to 30 feet away.

9. Digital Lighting Management (DLM) segment network – Linear topology, BACnet MS/TP network (1.5 twisted pair, shielded) to connect multiple DLM local networks for centralized control.

10. Network Bridge – Provides BACnet MS/TP-compliant digital networked communication between rooms, panels and the Segment Manager or building automation system (BAS) and automatically creates BACnet objects representative of connected devices.

11. Segment Manager – BACnet MS/TP-based controller with web browser-based user interface for system control, scheduling, power monitoring, room device parameter administration and reporting.

12. Programming and Configuration Software – Optional PC-native application capable of accessing DLM control parameters within a room, for the local network, via a USB

adapter, or globally, for many segment networks simultaneously, via BACnet/IP communication.

13. Digital Lighting Management Relay Panel and Zone Controller – Provides up to 8, 24, or 48 mechanically latching relays. Relays include a manual override and a single push-on connector for easy installation or removal from the panel. Panel accepts program changes from handheld configuration tool for date and time, location, holidays, event scheduling, button binding and group programming. Provides BACnet MS/TP-compliant digital networked communication between other lighting controls and/or building automation system (BAS). Zero relay Zone Controller primarily supports Digital Fixture Controller applications.

14. Emergency Lighting Control Unit (ELCU) – Allows a standard lighting control device to control emergency lighting in conjunction with normal lighting in any area within a building

1.4 LIGHTING CONTROL APPLICATIONS

A. Unless relevant provisions of the applicable local energy codes are more stringent, provide a minimum application of lighting controls as follows:

1. Space Control Requirements – Provide occupancy/vacancy sensors with Manual- or Partial-ON functionality in all spaces except toilet rooms, storerooms, library stacks, or other applications where hands-free operation is desirable and Automatic-ON occupancy sensors are more appropriate. Provide Manual-ON occupancy/vacancy sensors for any enclosed office, conference room, meeting room, open plan system and training room. For spaces with multiple occupants, or where line-of-sight may be obscured, provide ceiling- or corner-mounted sensors and Manual-ON switches.

2. Daylit Areas – Provide daylight-responsive automatic control in all spaces (conditioned or unconditioned) where daylight contribution is available as defined by relevant local building energy code:

    a. All luminaires within code-defined daylight zones shall be controlled separately from luminaires outside of daylit zones.

    b. Daytime setpoints for total ambient illumination (combined daylight and electric light) levels that initiate dimming shall be programmed in compliance with relevant local building energy codes.

    c. Multiple-level switched daylight harvesting controls may be utilized for areas marked on drawings.

    d. Provide smooth and continuous daylight dimming for areas marked on drawings. Daylighting control system may be designed to turn off electric lighting when daylight is at or above required lighting levels, only if system functions to turn lamps back on at dimmed level, rather than turning full-on prior to dimming.

3. Conference, meeting, training, auditoriums, and multipurpose rooms shall have controls that allow for independent control of each local control zone. Rooms larger than 300 square feet shall instead have at least four preset lighting scenes unless otherwise specified. Occupancy / vacancy sensors shall be provided to turn off all

lighting in the space. Spaces with up to four moveable walls shall include controls that can be reconfigured when the room is partitioned.

1.5 SUBMITTALS

A. Submittals Package: Submit the shop drawings, and the product data specified below at the same time as a package.

B. Shop Drawings:

1. Composite wiring and/or schematic diagram of each control circuit as proposed to be installed.

2. Show exact location of all digital devices, including at minimum sensors, load controllers, and switches for each area on reflected ceiling plans. (Contractor must provide AutoCAD format reflected ceiling plans.)

3. Provide room/area details including products and sequence of operation for each room or area. Illustrate typical acceptable room/area connection topologies.

4. Network riser diagram including floor and building level details. Include network cable specification and end-of-line termination details, if required. Illustrate points of connection to integrated systems. Coordinate integration with mechanical and/or other trades.

C. Product Data: Catalog sheets, specifications and installation instructions.

D. Include data for each device which:

1. Indicates where sensor is proposed to be installed.

2. Prove that the sensor is suitable for the proposed application.

1.6 QUALITY ASSURANCE

1.7 Manufacturer: Minimum 10 years experience in manufacture of lighting controls.

1.8 PROJECT CONDITIONS

A. Do not install equipment until following conditions can be maintained in spaces to receive equipment:

1. Ambient temperature: 0° to 40° C (32° to 104° F).

2. Relative humidity: Maximum 90 percent, non-condensing.

1.9 WARRANTY

A. Provide a five year limited manufacturer’s warranty on all room control devices and panels.

1.10 MAINTENANCE

A. Spare Parts:

1. Provide the minimum of 5% or [5] of each of the following spares of each product that are used on this project to be used for maintenance as listed below:

a. Single-zone room controller

b. Two-zone room controller

c. Three-zone room controller

d. Single-zone dimming controller

e. Two-zone dimming controller

f. Three-zone dimming controller

g. Fixture controller

h. Network bridge

i. Isolated auxiliary relay

j. Ceiling occupancy sensor (each type used)

k. Wall mount occupancy sensor (each type used)

l. Wall switch (each type used)

m. Interior photocell

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer:

1. Basis of design product: WattStopper Digital Lighting Management (DLM) or subject to compliance and prior approval with specified requirements of this section, one of the following:

    a. See Drawings for other approved manufacturers

1. Substitutions: All proposed substitutions (clearly delineated as such) must be submitted in writing for approval by the design professional a minimum of 10 working days prior to the bid date and must be made available to all bidders. Proposed substitutes must be accompanied by a review of the specification noting compliance on a line-by-line basis.

2.2 DIGITAL LIGHTING CONTROLS

A. Furnish the Company's system which accommodates the square-footage coverage requirements for each area controlled, utilizing room controllers, digital occupancy sensors, switches, daylighting sensors and accessories which suit the lighting and electrical system parameters.

2.3 DLM LOCAL NETWORK (Room Network)

A. The DLM local network is a free topology lighting control physical connection and communication protocol designed to control a small area of a building.

B. Features of the DLM local network include:

1. Plug n' Go™ automatic configuration and binding of occupancy sensors, switches and lighting loads to the most energy-efficient sequence of operation based upon the device attached.

2. Simple replacement of any device in the local DLM network with a standard off the shelf unit without requiring significant commissioning, configuration or setup.

3. Push n' Learn™ configuration to change the automatic configuration, including binding and load parameters without tools, using only the buttons on the digital devices in the local network.

4. Two-way infrared communications for control by handheld remotes, and configuration by a handheld tool including adjusting load parameters, sensor configuration and binding, within a line of sight of up to 30 feet from a sensor, wall switch or IR receiver.

C. Digital room devices connect to the local network using pre-terminated Cat 5e cables with RJ-45 connectors, which provide both data and power to room devices. Systems that utilize RJ-45 patch cords but do not provide serial communication data from individual end devices are not acceptable.

D. If manufacturer's pre-terminated Cat5e cables are not used for the installation, the contractor is responsible for testing each cable following installation and supplying manufacturer with test results.

E. WattStopper Product Number: LMRJ-Series

2.4 DIGITAL LOAD CONTROLLERS (ROOM AND FIXTURE CONTROLLERS)

A. Digital controllers for lighting loads automatically bind the room loads to the connected devices in the space without commissioning or the use of any tools. Room load controllers shall be provided to match the room lighting load control requirements. The controllers will be simple to install, and will not have dip switches or potentiometers, or require special configuration for standard Plug n' Go applications. The control units will include the following features:

1. Automatic room configuration to the most energy-efficient sequence of operation based upon the devices in the room.

2. Simple replacement – Using the default automatic configuration capabilities, a room controller may be replaced with an off-the-shelf.

3. Multiple room controllers connected together in a local network must automatically arbitrate with each other, without requiring any configuration or setup, so that individual load numbers are sequentially assigned using each controller's device ID's from highest to lowest.

4. Device Status LEDs to indicate:

    a. Data transmission

    b. Device has power

    c. Status for each load

d. Configuration status

5. Quick installation features including:
    a. Standard junction box mounting
    b. Quick low voltage connections using standard RJ-45 patch cable
6. Based on individual configuration, each load shall be capable of the following behavior on power up following the loss of normal power:
    a. Turn on to 100%
    b. Turn off
    c. Turn on to last level
7. Each load shall at a minimum be configurable to operate in the following sequences based on occupancy:
    a. Auto-on/Auto-off (Follow on and off)
    b. Manual-on/Auto-off (Follow off only)
8. The polarity of each load output shall be reversible, via digital configuration, so that on is off and off is on.
9. BACnet object information shall be available for the following objects:
    a. Load status
    b. Electrical current (when available)
    c. Total watts per controller
    d. Schedule state – normal or after-hours
    e. Demand response enable and disable
    f. Room occupancy status
    g. Total room lighting loads watts
    h. Total room watts/sq ft
    i. Force on/off all loads
10. UL 2043 plenum rated
11. Manual override and LED indication for each load
12. Dual voltage (120/277 VAC, 60 Hz), or 347 VAC, 60 Hz (selected models only). 120/277 volt models rated for 20A total load, derating to 16A required for some dimmed loads (forward phase dimming); 347 volt models rated for 15A total load.
13. Zero cross circuitry for each load

14. All digital parameter data programmed into an individual room controller shall be retained in non-volatile FLASH memory within the controller itself. Memory shall have an expected life of no less than 10 years.

B. On/Off Room Controllers shall include:

1. One or two relay configuration
2. Efficient 150 mA switching power supply
3. Three RJ-45 DLM local network ports with integral strain relief and dust cover
4. WattStopper product numbers: LMRC-101, LMRC-102

C. On/Off/Dimming enhanced Room Controllers shall include:

1. Real time current monitoring
2. Multiple relay configurations
    a. One, two or three relays (LMRC-21x series)
    b. One or two relays (LMRC-22x series)
3. Efficient 250 mA switching power supply
4. Four RJ-45 DLM local network ports with integral strain relief and dust cover
5. One dimming output per relay
    a. 0-10V Dimming - Where indicated, one 0-10 volt analog output per relay for control of compatible ballasts and LED drivers. The 0-10 volt output shall automatically open upon loss of power to the Room Controller to assure full light output from the controlled lighting. (LMRC-21x series)
    b. Line Voltage, Forward Phase Dimming - Where indicated, one forward phase control line voltage dimming output per relay for control of compatible two-wire or three-wire ballasts, LED drivers, MLV, forward phase compatible ELV, neon/cold cathode and incandescent loads. (LMRC-22x series)
    c. Each dimming output channel shall have an independently configurable minimum and maximum calibration trim level to set the dimming range to match the true dynamic range of the connected ballast or driver.
    d. The LED level indicators on bound dimming switches shall utilize this new maximum and minimum trim.
    e. Each dimming output channel shall have an independently configurable minimum and maximum trim level to set the dynamic range of the output within the new 0-100% dimming range defined by the minimum and maximum calibration trim.
    f. Calibration and trim levels must be set per output channel.

g. Devices that set calibration or trim levels per controller are not acceptable.

h. All configuration shall be digital. Devices that set calibration or trim levels per output channel via trim pots or dip-switches are not acceptable.

6. Each load shall have an independently configurable preset on level for Normal Hours and After Hours events to allow different dimmed levels to be established at the start of both Normal Hours and After Hours events.

7. Fade rates for dimming loads shall be specific to bound switch buttons, and the load shall maintain a default value for any bound buttons that do not specify a unique value.

8. The following dimming attributes may be changed or selected using a wireless configuration tool:

   a. Establish preset level for each load from 0-100%

   b. Set high and low trim for each load

   c. Set lamp burn in time for each load up to 100 hours

9. Override button for each load provides the following functions:

   a. Press and release for on/off control

   b. Press and hold for dimming control

10. WattStopper product numbers: LMRC-211, LRMC-212, LRMC-213, LMRC-221, LMRC-222
    .

D. Fixture Controllers shall include:

1. A form factor and product ratings to allow various OEM fixture manufacturers to mount the device inside the ballast/driver cavity of standard-sized fluorescent or LED general lighting fixtures.

2. One 3A 120/277V rated mechanically held relay.

3. Programmable behavior on power up following the loss of normal power:

   a. Turn on to 100%

   b. Turn off

   c. Turn on to last level

4. Requirement for 7 mA of 24VDC operating power from the DLM local network.

   a. The Fixture Controller does not require a connection to a neutral conductor to operate, and unlike other types of Load Controllers it does not contribute power to the DLM local network to drive accessory devices.

b. Power to drive the LMFC Fixture Controller electronics can come from any Room Load Controller, LMPB-100 Power Booster and/or LMZC-301 Zone Controller (described later in the LMCP LIGHTING CONTROL PANELS specification section).

5. 0-10V dimming capability via a single 0-10 volt analog output from the device for control of compatible ballasts and LED drivers. The 0-10 volt output shall automatically open upon loss of power to the Fixture Controller.

6. Terminals to connect an RJ-45 adaptor with 24" leads, mountable in a ½" KO, for connection to the DLM local network.

   a. The adaptor leads are insulated for use in a fixture cavity, and the lead length allows the OEM fixture manufacturer flexibility to position the Fixture Controller and the RJ45 jack in the best locations on each fixture.

7. A complete set of dimming features described above in the section detailing On/Off/Dimming Enhanced Room Controllers (subsection C.5 onward).

8. WattStopper product numbers: Fixture Controller: LMFC-011, DLM Cable Connector: LMFC-RJ-50-24, Power Booster: LMPB-100

2.5 DIGITAL WALL OR CEILING MOUNTED OCCUPANCY SENSOR

A. Wall or ceiling mounted (to suit installation) passive infrared (PIR), ultrasonic or dual technology digital (passive infrared and ultrasonic) occupancy sensor.

B. Digital Occupancy Sensors shall provide graphic LCD display for digital calibration and electronic documentation. Features include the following:

   1. Digital calibration and pushbutton configuration for the following variables:

      a. Sensitivity – 0-100% in 10% increments

      b. Time delay – 1-30 minutes in 1 minute increments

      c. Test mode – Five second time delay

      d. Detection technology – PIR, Ultrasonic or Dual Technology activation and/or re-activation.

      e. Walk-through mode

   2. Load parameters including Auto/Manual-ON, blink warning, and daylight enable/disable when photosensors are included in the DLM local network.

   3. Programmable control functionality including:

      a. Each sensor may be programmed to control specific loads within a local network.

      b. Sensor shall be capable of activating one of 16 user-definable lighting scenes.

c. Adjustable retrigger time period for manual-on loads. Load will retrigger (turn on) automatically within a configurable period of time (default 10 seconds) after turning off.

d. On dual technology sensors, independently configurable trigger modes are available for both Normal (NH) and After Hours (AH) time periods. The retrigger mode can be programmed to use the following technologies:

e. Ultrasonic and Passive Infrared

f. Ultrasonic or Passive Infrared

g. Ultrasonic only

h. Passive Infrared only

i. Independently configurable sensitivity settings for passive infrared and ultrasonic technologies (on dual technology sensors) for both Normal (NH) and After Hour (AH) time periods.

4. One or two RJ-45 port(s) for connection to DLM local network.

5. Two-way infrared (IR) transceiver to allow remote programming through handheld commissioning tool and control by remote personal controls.

6. Device Status LEDs, which may be disabled for selected applications, including:

   a. PIR detection

   b. Ultrasonic detection

   c. Configuration mode

   d. Load binding

7. Assignment of occupancy sensor to a specific load within the room without wiring or special tools.

8. Manual override of controlled loads.

9. All digital parameter data programmed into an individual occupancy sensor shall be retained in non-volatile FLASH memory within the sensor itself. Memory shall have an expected life of no less than 10 years.

C. BACnet object information shall be available for the following objects:

   1. Detection state

   2. Occupancy sensor time delay

   3. Occupancy sensor sensitivity, PIR and Ultrasonic

D. Units shall not have any dip switches or potentiometers for field settings.

E. Multiple occupancy sensors may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration will be required.

F. WattStopper product numbers: LMPX, LMDX, LMPC, LMUC, LMDC

2.6 DIGITAL WALL SWITCH OCCUPANCY SENSORS

A. Wallbox mounted passive infrared PIR or dual technology (passive infrared and ultrasonic) digital occupancy sensor with 1 or 2 switch buttons.

B. Digital Occupancy Sensors shall provide scrolling LCD display for digital calibration and electronic documentation. Features include the following:

1. Digital calibration and pushbutton configuration for the following variables:

a. Sensitivity – 0-100% in 10% increments

b. Time delay – 1-30 minutes in 1 minute increments

c. Test mode – Five second time delay

d. Detection technology – PIR, Dual Technology activation and/or re-activation.

e. Walk-through mode

f. Load parameters including Auto/Manual-ON, blink warning, and daylight enable/disable when photosensors are included in the DLM local network.

2. Programmable control functionality including:

a. Each sensor may be programmed to control specific loads within a local network.

b. Sensor shall be capable of activating one of 16 user-definable lighting scenes.

c. Adjustable retrigger time period for manual-on loads. Load will retrigger (turn on) automatically during the configurable period of time (default 10 seconds) after turning off.

d. On dual technology sensors, independently configurable trigger modes are available for both Normal (NH) and After Hours (AH) time periods. The retrigger mode can be programmed to use the following technologies:

i Ultrasonic and Passive Infrared

ii Ultrasonic or Passive Infrared

iii Ultrasonic only

iv Passive Infrared only

3. Independently configurable sensitivity settings for passive infrared and ultrasonic technologies (on dual technology sensors) for both Normal (NH) and After Hour (AH) time periods.

4. Two RJ-45 ports for connection to DLM local network.
5. Two-way infrared (IR) transceiver to allow remote programming through handheld configuration tool and control by remote personal controls.
6. Device Status LEDs including
    a. PIR detection
    b. Ultrasonic detection
    c. Configuration mode
    d. Load binding
7. Assignment of any occupancy sensor to a specific load within the room without wiring or special tools.
8. Assignment of local buttons to specific loads within the room without wiring or special tools
9. Manual override of controlled loads
10. All digital parameter data programmed into an individual wall switch sensor shall be retained in non-volatile FLASH memory within the wall switch sensor itself. Memory shall have an expected life of no less than 10 years.

C. BACnet object information shall be available for the following objects:
    1. Detection state
    2. Occupancy sensor time delay
    3. Occupancy sensor sensitivity, PIR and Ultrasonic
    4. Button state
    5. Switch lock control
    6. Switch lock status

D. Units shall not have any dip switches or potentiometers for field settings.

E. Multiple occupancy sensors may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration will be required.

F. Two-button wall switch occupancy sensors, when connected to a single relay dimming room or fixture controller, shall operate in the following sequence as a factory default:
    1. Left button
        a. Press and release - Turn load on
        b. Press and hold - Raise dimming load
    2. Right button
        a. Press and release - Turn load off

b. Press and hold - Lower dimming load

G. Low voltage momentary pushbuttons shall include the following features:

1. Load/Scene Status LED on each switch button with the following characteristics:

a. Bi-level LED

b. Dim locator level indicates power to switch

c. Bright status level indicates that load or scene is active

2. The following button attributes may be changed or selected using a wireless configuration tool:

a. Load and Scene button function may be reconfigured for individual buttons (from Load to Scene, and vice versa).

b. Individual button function may be configured to Toggle, On only or Off only.

c. Individual scenes may be locked to prevent unauthorized change.

d. Fade Up and Fade Down times for individual scenes may be adjusted from 0 seconds to 18 hours.

e. Ramp rate may be adjusted for each dimmer switch.

f. Switch buttons may be bound to any load on any load controller or relay panel and are not load type dependent; each button may be bound to multiple loads.

g. WattStopper part numbers: LMPW, LMDW. Available in white, light almond, ivory, grey, red and black; compatible with wall plates with decorator opening.

2.7 DIGITAL WALL SWITCHES

A. Low voltage momentary pushbutton switches in 1, 2, 3, 4, 5 and 8 button configuration. Wall switches shall include the following features:

1. Two-way infrared (IR) transceiver for use with personal and configuration remote controls.

2. Removable buttons for field replacement with engraved buttons and/or alternate color buttons. Button replacement may be completed without removing the switch from the wall.

3. Configuration LED on each switch that blinks to indicate data transmission.

4. Load/Scene Status LED on each switch button with the following characteristics:

a. Bi-level LED

b. Dim locator level indicates power to switch

c. Bright status level indicates that load or scene is active

d. Dimming switches shall include seven bi-level LEDs to indicate load levels using 14 steps.

5. Programmable control functionality including:

a. Button priority may be configured to any BACnet priority level, from 1-16, corresponding to networked operation allowing local actions to utilize life safety priority

b. Scene patterns may be saved to any button other than dimming rockers. Once set, buttons may be digitally locked to prevent overwriting of the preset levels.

6. All digital parameter data programmed into an individual wall switch shall be retained in non-volatile FLASH memory within the wall switch itself. Memory shall have an expected life of no less than 10 years.

B. BACnet object information shall be available for the following objects:

1. Button state

2. Switch lock control

3. Switch lock status

C. Two RJ-45 ports for connection to DLM local network.

D. Multiple digital wall switches may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration shall be required to achieve multi-way switching.

E. The following switch attributes may be changed or selected using a wireless configuration tool:

F. Load and Scene button function may be reconfigured for individual buttons (from Load to Scene, and vice versa).

1. Individual button function may be configured to Toggle, On only or Off only.

2. Individual scenes may be locked to prevent unauthorized change.

3. Fade Up and Fade Down times for individual scenes may be adjusted from 0 seconds to 18 hours.

4. Ramp rate may be adjusted for each dimmer switch.

5. Switch buttons may be bound to any load on any load controller or relay panel and are not load type dependant; each button may be bound to multiple loads.

6. WattStopper product numbers: LMSW-101, LMSW-102, LMSW-103, LMSW-104, LMSW-105, LMSW-108, LMDM-101. Available in white, light almond, ivory, grey, red

and black; compatible with wall plates with decorator opening.

2.8 DIGITAL DAYLIGHTING SENSORS

A. Digital daylighting sensors shall work with load controllers and relay panels to provide automatic switching, bi-level, or tri-level or dimming daylight harvesting capabilities for any load type connected to the controller or panel. Daylighting sensors shall be interchangeable without the need for rewiring.

1. Closed loop sensors measure the ambient light in the space and control a single lighting zone.

2. Open loop sensors measure incoming daylight in the space, and are capable of controlling up to three lighting zones.

3. Dual loop sensors measure both ambient and incoming daylight in the space to insure that proper light levels are maintained as changes to reflective materials are made in a single zone.

B. Digital daylighting sensors shall include the following features:

1. The sensor's internal photodiode shall only measure lightwaves within the visible spectrum. The photodiode's spectral response curve shall closely match the entire photopic curve. The photodiode shall not measure energy in either the ultraviolet or infrared spectrums. The photocell shall have a sensitivity of less than 5% for any wavelengths less than 400 nanometers or greater than 700 nanometers.

2. Sensor light level range shall be from 1-6,553 footcandles (fc).

3. The capability of ON/OFF, bi-level or tri-level switching, or dimming, for each controlled zone, depending on the selection of load controller(s) and load binding to controller(s).

4. For switching daylight harvesting, the photosensor shall provide a field-selectable deadband, or a separation, between the "ON Setpoint" and the "OFF Setpoint" that will prevent the lights from cycling excessively after they turn off.

5. For dimming daylight harvesting, the photosensor shall provide the option, when the daylight contribution is sufficient, of turning lights off or dimming lights to a field-selectable minimum level.

6. Photosensors shall have a digital, independently configurable fade rate for both increasing and decreasing light level in units of percent per second.

7. Photosensors shall provide adjustable cut-off time. Cut-off time is defined by the number of selected minutes the load is at the minimum output before the load turns off. Selectable range between 0-240 minutes including option to never cut-off.

8. Optional wall switch override shall allow occupants to reduce lighting level to increase energy savings or, if permitted by system administrator, raise lighting levels for a selectable period of time or cycle of occupancy.

9. Integral infrared (IR) transceiver for configuration and/or commissioning with a handheld configuration tool, to transmit detected light level to wireless configuration tool, and for communication with personal remote controls.
10. Configuration LED status light on device that blinks to indicate data transmission.
11. Status LED indicates test mode, override mode and load binding.
12. Recessed switch on device to turn controlled load(s) ON and OFF.
13. BACnet object information shall be available for the following daylighting sensor objects, based on the specific photocell's settings:
    a. Light level
    b. Day and night setpoints
    c. Off time delay
    d. On and off setpoints
    e. Up to three zone setpoints
    f. Operating mode – on/off, bi-level, tri-level or dimming
14. One RJ-45 port for connection to DLM local network.
15. A choice of accessories to accommodate multiple mounting methods and building materials. The photosensors may be mounted on a ceiling tile, skylight light well, suspended lighting fixture or backbox. Standard tube photosensors accommodate mounting materials from 0-0.62" thickness (LMLS-400, LMLS-500). Extended tube photosensors accommodate mounting materials from 0.62"-1.25" thickness (LMLS-400-L, LMLS-500-L). Mounting brackets are compatible with J boxes (LMLS-MB1) and wall mounting (LMLS-MB2). LMLS-600 photosensor to be mounted on included bracket below skylight well.
16. Any load or group of loads in the room can be assigned to a daylighting zone
17. Each load within a daylighting zone can be individually enabled or disabled for discrete control (load independence).
18. All digital parameter data programmed into a photosensor shall be retained in non-volatile FLASH memory within the photosensor itself. Memory shall have an expected life of no less than 10 years.

C. Closed loop digital photosensors shall include the following additional features:
    1. An internal photodiode that measures light in a 100-degree angle, cutting off the unwanted light from bright sources outside of this cone.
    2. Automatic self-calibration, initiated from the photosensor, a wireless configuration tool or a PC with appropriate software.
    3. Automatically establishes application-specific setpoints following self-calibration. For switching operation, an adequate deadband between the ON and OFF setpoints shall prevent the lights from cycling; for dimming operation a sliding setpoint control

algorithm with separate Day and Night setpoints shall prevent abrupt ramping of loads.

4. WattStopper Product Number: LMLS-400, LMLS-400-L.

D. Open loop digital photosensors shall include the following additional features:

1. An internal photodiode that measures light in a 60-degree angle (cutting off the unwanted light from the interior of the room).

2. Automatically establishes application-specific setpoints following manual calibration using a wireless configuration tool or a PC with appropriate software. For switching operation, an adequate deadband between the ON and OFF setpoints for each zone shall prevent the lights from cycling; for dimming operation, a proportional control algorithm shall maintain the design lighting level in each zone.

3. Each of the three discrete daylight zones can include any non overlapping group of loads in the room.

4. WattStopper Product Number: LMLS-500, LMLS-500-L.

E. Dual loop digital photosensors shall include the following additional features:

1. Close loop portion of dual loop device must have an internal photodiode that measures light in a 100 degree angle, cutting off the unwanted light from sources outside of this con

2. Open loop portion of dual loop device must have an internal photodiode that can measure light in a 60 degree angle, cutting off the unwanted light from the interior of the room.

3. Automatically establishes application-specific set-points following self-calibration. For switching operation, an adequate deadband between the ON and OFF setpoints shall prevent the lights from cycling; for dimming operation a sliding setpoint control algorithm with separate Day and Night setpoints shall prevent abrupt ramping of load.

4. Device must reference closed loop photosensor information as a base line reference. The device must be able to analyze the open loop photosensor information to determine if an adjustment in light levels is required.

5. Device must be able to automatically commission setpoints each night to provide adjustments to electrical lighting based on changes in overall lighting in the space due to changes in reflectance within the space or changes to daylight contribution based on seasonal changes.

6. Device must include extendable mounting arm to properly position sensor within a skylight well.

7. WattStopper product number LMLS-600

2.9 DIGITAL PARTITION CONTROLS

A. Partition controls shall enable manual or automatic coordination of lighting controls in flexible spaces with up to four moveable walls by reconfiguring the connected digital switches and occupancy sensors.

B. Four-button low voltage pushbutton switch for manual control.

1. Two-way infrared (IR) transceiver for use with configuration remote control.
2. Removable buttons for field replacement with engraved buttons and/or alternate color buttons. Button replacement may be completed without removing the switch from the wall.
3. Configuration LED on each switch that blinks to indicate data transmission.
4. Each button represents one wall; Green button LED indicates status.
5. Two RJ-45 ports for connection to DLM local network.
6. WattStopper part number: LMPS-104. Available in white, light almond, ivory, grey and black; compatible with wall plates with decorator opening.

C. Contact closure interface for automatic control via input from limit switches on movable walls (by others).

1. Operates on Class 2 power supplied by DLM local network.
2. Includes 24VDC output and four input terminals for maintained third party contract closure inputs.
3. Input max. sink/source current: 1-5mA
    a. Logic input signal voltage High: >18VDC
    b. Logic input signal voltage Low: <2VDC
4. Four status LEDs under hinged cover indicate if walls are open or closed; supports LMPS-104 as remote status indicator.
5. Two RJ-45 ports for connection to DLM local network.
6. WattStopper part number: LMIO-102

2.10 HANDHELD AND COMPUTER CONFIGURATION TOOLS

A. A wireless configuration tool facilitates optional customization of DLM local networks using two-way infrared communications, while PC software connects to each local network via a USB interface.

B. Features and functionality of the wireless configuration tool shall include but not be limited to:

1. Two-way infrared (IR) communication with DLM IR-enabled devices within a range of approximately 30 feet.
2. High visibility organic LED (OLED) display, pushbutton user interface and menu-driven operation.

3. Must be able to read and modify parameters for load controllers and relay panels, occupancy sensors, wall switches, daylighting sensors, network bridges, and identify DLM devices by type and serial number.

4. Save up to eight occupancy sensor setting profiles, and apply profiles to selected sensors.

5. Temporarily adjust light level of any load(s) on the local network, and incorporate those levels in scene setting. Set room mode for testing of Normal Hours (NH) and After Hours (AH) parameter settings.

6. Adjust or fine-tune daylighting settings established during auto-configuration, and input light level data to complete configuration of open loop daylighting controls.

7. Set room mode for testing of Normal Hours (NH) and After Hours (AH) parameter settings.

8. Verify status of building level network devices.

C. WattStopper Product Numbers: LMCT-100, LMCI-100/LMCS-100

2.11 DLM SEGMENT NETWORK (Room to Room Network)

A. The segment network shall be a linear topology, BACnet-based MS/TP subnet to connect DLM local networks (rooms) and LMCP relay panels for centralized control.

1. Each connected DLM local network shall include a single network bridge (LMBC-300), and the network bridge is the only room-based device that is connected to the segment network.

2. Network bridges, relay panels and segment managers shall include terminal blocks, with provisions for separate “in” and “out” terminations, for segment network connections.

3. The segment network shall utilize 1.5 twisted pair, shielded, cable supplied by the lighting control manufacturer. The maximum cable run for each segment is 4,000 feet. Conductor-to-conductor capacitance of the twisted pair shall be less than 30 pf/ft and have a characteristic impedance of 120 Ohms.

4. Network signal integrity requires that each conductor and ground wire be correctly terminated at every connected device.

5. Substitution of manufacturer-supplied cable must be pre-approved: Manufacturer will not certify network reliability, and reserves the right to void warranty, if non-approved cable is installed, and if terminations are not completed according to manufacturer’s specific requirements.

6. Segment networks shall be capable of connecting to BACnet-compliant BAS (provided by others) either directly, via MS/TP, or through NB-ROUTERs, via BACnet/IP or BACnet/Ethernet. Systems whose room-connected network infrastructure require gateway devices to provide BACnet data to a BAS are unacceptable.

B. WattStopper Product Number: LM-MSTP, LM-MSTP-DB

2.12 NETWORK BRIDGE

A. The network bridge module connects a DLM local network to a BACnet-compliant segment network for communication between rooms, relay panels and a segment manager or BAS. Each local network shall include a network bridge component to provide a connection to the local network room devices. The network bridge shall use industry standard BACnet MS/TP network communication and an optically isolated EIA/TIA RS-485 transceiver.

1. The network bridge shall be provided as a separate module connected on the local network through an available RJ-45 port.

2. Provide Plug n' Go operation to automatically discover room devices connected to the local network and make all device parameters visible to the segment manager via the segment network. No commissioning shall be required for set up of the network bridge on the local network.

3. The network bridge shall automatically create standard BACnet objects for selected DLM devices to allow any BACnet-compliant BAS to include lighting control and power monitoring features as provided by the DLM devices on each local network. BACnet objects will be created for the addition or replacement of any given DLM device for the installed life of the system. Products requiring that an application-specific point database be loaded to create or map BACnet objects are not acceptable. Systems not capable of providing BACnet data for control devices via a dedicated BACnet Device ID and physical MS/TP termination per room are not acceptable. Standard BACnet objects shall be provided as follows:

    a. Read/write the normal or after hours schedule state for the room

    b. Read the detection state of each occupancy sensor

    c. Read the aggregate occupancy state of the room

    d. Read/write the On/Off state of loads

    e. Read/write the dimmed light level of loads

    f. Read the button states of switches

    g. Read total current in amps, and total power in watts through the load controller

    h. Read/write occupancy sensor time delay, PIR sensitivity and ultrasonic sensitivity settings

    i. Activate a preset scene for the room

    j. Read/write daylight sensor fade time and day and night setpoints

    k. Read the current light level, in footcandles, from interior and exterior photosensors and photocells

    l. Set daylight sensor operating mode

m. Read/write wall switch lock status

n. Read watts per square foot for the entire controlled room

o. Write maximum light level per load for demand response mode

p. Read/write activation of demand response mode for the room

q. Activate/restore demand response mode for the room

B. WattStopper product numbers: LMBC-300

2.13 LMCP LIGHTING CONTROL PANELS AND LMZC ZONE CONTROLLER

A. HARDWARE:
Provide LMCP lighting control panels in the locations and capacities as indicated on the plans and schedules. Each panel shall be of modular construction and consist of the following components:

1. Enclosure/Tub shall be NEMA 1, sized to accept an interior with 1 - 8 relays, 1 - 24 relays and 6 four-pole contactors, or 1 - 48 relays and 6 four-pole contactors.

2. Cover shall be configured for surface or flush wall mounting of the panel as indicated on the plans. LMCP panel cover shall have a hinged and lockable door with restricted access to line voltage section of the panel.

3. Interior assembly shall be supplied as a factory assembled component specifically designed and listed for field installation. The interior construction shall provide total isolation of high voltage (Class 1) wiring from low voltage (Class 2) wiring within the assembled panel. The interior assembly shall include intelligence boards, power supply, DIN rails for mounting optional Class 2 control devices, and individually replaceable latching type relays. The panel interiors shall include the following features:

a. Removable, plug-in terminal blocks with connections for all low voltage terminations.

b. Individual terminal block, override pushbutton, and LED status light for each relay.

c. Direct wired switch inputs associated with each relay shall support 2-wire momentary switches only.

d. Digital inputs (four RJ-45 jacks) shall support 1-, 2-, 3-, 4-, and 8-button digital switches; digital IO modules capable of receiving 0-5V or 0-10V analog photocell inputs; digital IO modules capable of receiving momentary or maintained contact closure inputs or analog sensor inputs; digital daylighting sensors; and digital occupancy sensors. Inputs are divided into two separate digital networks, each capable of supplying 250mA to connected devices.

e. True relay state shall be indicated by the on-board LED and shall be available to external control devices and systems via BACnet.

f. Automatically sequenced operation of relays to reduce impact on the electrical distribution system when large loads are controlled simultaneously.

g. Group and pattern control of relays shall be provided through a simple keypad interface from a handheld IR programmer. Any set of relays can be associated with a group for direct on/off control or pattern (scene) control via a simple programming sequence using the relay override pushbuttons and LED displays for groups 1-8 or a handheld IR programmer for groups 1-99.

h. Relay group status for shall be provided through LED indicators for groups 1-8 and via BACnet for groups 1-99. A solid LED indicates that the last group action called for an ON state and relays in the group are on or in a mixed state.

4. Single-pole latching relays with modular plug-in design. Relays shall provide the following ratings and features:

   a. Electrical:

      i 30 amp ballast at 277V

      ii 20 amp ballast at 347V

      iii 20amp tungsten at 120V

      iv 30 amp resistive at 347V

      v 1.5 HP motor at 120V

      vi 14,000 amp short circuit current rating (SCCR) at 347V

      vii Relays shall be specifically UL 20 listed for control of plug-loads

   b. Mechanical:

      i Replaceable, ½" KO mounting with removable Class 2 wire harness.

      ii Actuator on relay housing provides manual override and visual status indication, accessible from Class 2 section of panel.

      iii Dual line and load terminals each support two #14 - #12 solid or stranded conductors.

      iv Tested to 300,000 mechanical on/off cycles.

5. Isolated low voltage contacts provide for true relay status feedback and pilot light indication.

6. Power supply shall be a multi-voltage transformer assembly with rated power to supply all electronics, occupancy sensors, switches, pilot lights, and photocells as necessary to meet the project requirements. Power supply to have internal over-current protection with automatic reset and metal oxide varistor protection.

7. Where indicated, lighting control panels designated for control of emergency lighting shall be provided with factory installed provision for automatic by pass of relays controlling emergency circuits upon loss of normal power. Panels shall be properly listed and labeled for use on emergency lighting circuits and shall meet the requirements of UL924 and NFPA 70 - Article 700.

8. Integral system clock shall provide scheduling capabilities for panel-only projects without DLM segment networks or BAS control.

    a. Each panel shall include digital clock capability able to issue system wide automation commands to up to (11) eleven other panels for a total of (12) twelve networked lighting control panels. The clock shall provide capability for up to 254 independent schedule events per panel for each of the ninety-nine system wide channel groups.

    b. The clock capability of each panel shall support the time-based energy saving requirements of applicable local energy codes.

    c. The clock module shall provide astronomic capabilities, time delays, blink warning, daylight savings, and holiday functions and will include a battery back up for the clock function and program retention in non-volatile FLASH memory. Clocks that require multiple events to meet local code lighting shut off requirements shall not be allowed.

    d. The clock capability of each panel shall operate on a basis of ON/OFF or Normal Hours/After Hours messages to automation groups that implement pre-configured control scenarios. Scenarios shall include:

        i Scheduled ON / OFF

        ii Manual ON / Scheduled OFF

        iii Astro ON / OFF (or Photo ON / OFF)

        iv Astro and Schedule ON / OFF (or Photo and Schedule ON / OFF)

    e. The user interface shall be a portable IR handheld remote control capable of programming any panel in the system (LMCT-100)

    f. The clock capability of each panel shall employ non-volatile memory and shall retain user programming and time for a minimum of 10 years.

    g. Schedules programmed into the clock of any one panel shall be capable of executing panel local schedule or Dark/Light (photocell or Astro) events for that panel in the event that global network communication is lost. Lighting control panels that are not capable of executing events independently of the global network shall not be acceptable.

9. The lighting control panel can operate as a stand-alone system, or can support schedule, group, and photocell control functions, as configured in a Segment Manager controller, via a segment network connection.

10. The lighting control panel shall support digital communications to facilitate the extension of control to include interoperation with building automation systems and

other intelligent field devices. Digital communications shall be RS485 MS/TP-based using the BACnet® protocol.

a. The panel shall have provision for an individual BACnet device ID and shall support the full 222 range (0 – 4,193,304). The device ID description property shall be writable via the network to allow unique identification of the lighting control panel on the network.

b. The panel shall support MS/TP MAC addresses in the range of 0 – 127 and baud rates of 9600k, 38400k, 76800k, and 115.2k bits per second.

c. Lighting control relays shall be controllable as binary output objects in the instance range of 1 – 64. The state of each relay shall be readable and writable by the BAS via the object present value property.

d. Lighting control relays shall report their true on/off state as binary input objects in the instance range of 1 – 64.

e. The 99 group Normal Hours/After Hours control objects associated with the panel shall be represented by binary value objects in the instance range of 201 – 299. The occupancy state of each channel group shall be readable and writable by the BAS via the object present value property. Commanding 1 to a channel group will put all relays associated with the channel into the normal hours mode. Commanding 0 or NULL shall put the relays into the after hours mode.

f. Setup and commissioning of the panel shall not require manufacturer-specific software or a computer. All configuration of the lighting control panel shall be performed using standard BACnet objects or via the handheld IR programming remote. Provide BACnet objects for panel setup and control as follows:

   i Binary output objects in the instance range of 1 – 64 (one per relay) for on/off control of relays.

   ii Binary value objects in the instance range of 1 – 99 (one per channel) for normal hours/after hours schedule control.

   iii Binary input objects in the instance range of 1 – 64 (one per relay) for reading true on/off state of the relays.

   iv Analog value objects in the instance range of 101 – 199 (one per channel group) shall assign a blink warn time value to each channel. A value of 5 shall activate the blink warn feature for the channel and set a 5-minute grace-time period. A value of 250 shall activate the sweep feature for the channel and enable the use of sweep type automatic wall switches.

g. The description property for all objects shall be writable via the network and shall be saved in non-volatile memory within the panel.

h. The BO and BV 1 – 99 objects shall support BACnet priority array with a relinquish default of off and after hours respectively. Prioritized writes to the channel BV objects shall propagate prioritized control to each member relay in a way analogous to the BACnet Channel object described in addendum aa. (http://www.bacnet.org/Addenda/Add-135-2010aa.pdf)

i. Panel-aggregate control of relay Force Off at priority 2 shall be available via a single BV5 object. Force On at priority 1 shall be available via a single BV4 object.

j. Lockout of all digital switch buttons connected to a given panel shall be command-able via a single BV2 object. The lock status of any connected switch station shall be represented as BV101-196.

11. In addition to the LMCP Relay Panels, an LMZC Zone Controller panel shall be available for zero-relay applications. The panel is designed for applications where LMFC-011 Fixture Controllers or other distributed load controllers are used to switch and/or dim the controlled loads. Key similarities to and differences from the LMCP panel design shall include:

    a. The LMZC shall use the same intelligence board as the LMCP relay panel.

    b. The LMZC shall not include relay driver boards or relays.

    c. The LMZC shall have a removable interior section to facilitate installation, and a Tub/Cover. Cover is for surface mounting applications only.

    d. The LMZC tub shall have two interior KOs to allow installation of LMPB-100 Power Boosters. Each installed Power Booster can provide an additional 150 mA for either of the two available DLM local networks provided by the LMZC.

    e. All programming and networking (whether DLM Local Network and/or Segment Network) capabilities in the LMZC Zone Controller shall be similar to capabilities for LMCP relay panels, except for functions designed for panel-mounted HDR relays.

12. To aid in project start up, if LMFC Fixture Controllers are connected to an LMZC Zone Controller, Plug n' Go automatic configuration will establish a unique sequence of operation so that all LMFC-controlled fixtures will turn on to 50% output when any digital occupancy sensor detects motion..

13. WattStopper Product Number: Relay Panels: LMCP8, LMCP24 or LMCP48, Zone Controller: LMZC-301.

B. USER INTERFACE

Each lighting control panel system shall be supplied with at least (1) handheld configuration tool (LMCT-100). As a remote programming interface the configuration tool shall allow setup, configuration, and diagnostics of the panel without the need for software or connection of a computer. The user interface shall have the following panel-specific functions as a minimum:

1. Set network parameters including panel device ID, MS/TP MAC address, baud rate and max master range.

2. Relay Group creation of up to 99 groups. Group creation shall result in programming of all seven key relay parameters for member relays. The seven parameters are as follows: After-hours Override Time Delay, Normal Hours Override Time Delay, Action on Transition to Normal Hours, Action on Transition to After Hours, Sensor Action During Normal Hours, Sensor Action During After Hours, Blink-Warn Time for After Hours.

3. Program up to 254 separate scheduled events. Events shall occur on seven day intervals with each day selectable as active or inactive, and shall be configurable as to whether the event is active on holidays. Holidays are also defined through the User Interface.

4. Program up to 32 separate Dark/Light events. Events shall have a selectable source as either calculated Astro with delay, or a digital IO module with an integral 0-5V or 0-10V analog photocell. Dark/Light events shall occur on seven day intervals with each day selectable as active or inactive, and shall be configurable as to whether the event is active on holidays.

5. Button binding of digital switches to groups shall be accessible via the handheld IR remote and accomplished from the digital switch station.

6. Programming of panel location information shall be accomplished by the handheld IR remote and include at a minimum LAT, LON, DST zone, and an approximate city/state location.

7. WattStopper Product Number: LMCT-100

2.14 SEGMENT MANAGER

A. For networked applications, the Digital Lighting Management system shall include at least one segment manager to manage network communication. It shall be capable of serving up a graphical user interface via a standard web browser utilizing either unencrypted TCP/IP traffic via a configurable port (default is 80) or 256 bit AES encrypted SSL TCP/IP traffic via a configurable port (default is 443).

B. Each segment manager shall have integral support for at least three segment networks. Segment networks may alternately be connected to the segment manger via external BACnet-to-IP interface routers and switches, using standard Ethernet structured wiring. Each router shall accommodate one segment network. Provide the quantity of routers and switches as shown on the plans.

C. Operational features of the Segment Manager shall include the following:

1. Connection to PC or LAN via standard Ethernet TCP/IP via standard Ethernet TCP/IP with the option to use SSL encrypted connections for all traffic.

2. Easy to learn and use graphical user interface, compatible with Internet Explorer 8, or equal browser. The Segment Manager shall not require installation of any lighting control software on an end-user PC.

3. Log in security capable of restricting some users to view-only or other limited operations.

4. Segment Manager shall provide two main sets of interface screens – those used to initially configure the unit (referred to as the config screens), and a those used to allow users to dynamic monitor the performance of their system, and provide a centralized scheduling interface.

   Capabilities using the Config Screens shall include:

   a. Automatic discovery of DLM devices and relay panels on the segment network(s). Commissioning beyond activation of the discovery function shall not be required to provide communication, monitoring or control of all local networks and lighting control panels.

   b. Allow information for all discovered DLM devices to be imported into the Segment Manager via a single XML based site file from the WattStopper LMCS Software, significantly reducing the time needed to make a system usable by the end user. Importable information can include text descriptions of every DLM component and individual loads, and automatic creation of room location information and overall structure of DLM network. Info entered into LMCS should not have to be re-entered manually via keystrokes into the Segment Manager

   c. After discovery, all rooms and panels shall be presented in a standard navigation tree format. Selecting a device from the tree will allow the device settings and operational parameters to be viewed and changed by the user.

   d. Ability to view and modify DLM device operational parameters. It shall be possible to set device parameters independently for normal hours and after hours operation including sensor time delays and sensitivities, and load response to sensor including Manual-On or Auto-On.

   e. Provide capabilities for integration with a BAS via BACnet protocol. At a minimum, the following points shall be available to the BAS via BACnet IP connection to the segment manager: room occupancy state; room schedule mode; room switch lock control; individual occupancy sensor state; room lighting power; room plug-load power; load ON/OFF state; load dimming level; panel channel schedule state; panel relay state; and Segment Manager Group schedule state control. Any of above items shall be capable of being moved into an “Export Table” that will provide any integrator with only the data they need, and by using the Export Table effectively create a firewall between the integrator’s request for info and the overall system performance.

5. Capabilities using the Segment Manager’s Dashboard Screens shall include:

   a. A dynamic “tile” based interface that allows easy viewing of each individual room’s lighting and plug load power consumption, and lighting and plug load power density (power consumption information requires

Enhanced DLM Room and Plug Load Controllers with integral current transducers such as LMRC-21x).Tiles will be automatically organized according to location so a single tile for the building summarizes all information for tiles beneath it on every floor, in every area, in every room. Tiles shall be color coded based on three energy target parameters, allowing an owner to quickly identify rooms that are not performing efficiently. Tiles for rooms with occupancy sensors shall include an icon to indicate whether that room is occupied. Tiles shall be clickable, and when clicked the underlying hierarchical level of tiles shall become visible. The tile interface shall be accessible via mouse, or touch screen devices. Tiles shall be created automatically by the segment manager, based on the information found during the device discovery and/or information included in a file imported in from LMCS (such as tagged descriptions for each room) without any custom programming.

b. Ability to set up schedules for DLM local networks (rooms) and panels. Schedules shall be capable of controlling individual rooms with either on/off or normal hours/after hours set controlled zones or areas to either a normal hours or after hours mode of operation. Support for annual schedules, holiday schedules and unique date-bound schedules, as well as astro On or astro Off events with offsets. Schedules shall be viable graphically as time bars in a screen set up to automatically show scheduled events by day, week or month.

c. Ability to provide a simple time vs. power graph based on information stored in each Segment Manager's memory (typically two to three days' data).

6. If shown in the contract drawings, Segment Managers shall be integrated into a larger control network by the addition of a Network Supervisor package. The Supervisor is a server level computer running a version of the Segment Manager interface software with dedicated communication and networking capability, able to pull information automatically from each individual Segment Manager in the network. By using a Supervisor, information for individual Segment Managers can be accessed and stored on the Supervisor's hard drive, eliminating the risk of data being overwritten after a few days because of Segment Manager memory limits.

7. The Segment Manager shall allow access and control of the overall system database via Native Niagara AX FOX connectivity. Systems that must utilize a Tridium Niagara controller in addition to the programming, scheduling and configuration server are not acceptable.

D. Segment Manager shall support multiple DLM rooms as follows:

1. Support up to 120 network bridges and 900 digital in-room devices (LMSM-3E).

2. Support up to 300 network bridges and 2,200 digital in room devices, connected via network routers and switches (LMSM-6E).

E. WattStopper Product Numbers: LMSM-3E, LMSM-6E, LM-SUPERVISOR, NB-ROUTER, NB-SWITCH, NB-SWITCH-8, NB-SWITCH-16.

2.15 PROGRAMMING, CONFIGURATION AND DOCUMENTATION SOFTWARE

A. PC-native application for optional programming of detailed technician-level parameter information for all DLM products, including all parameters not accessible via BACnet and the handled IR configuration tool. Software must be capable of accessing room-level parameter information locally within the room when connected via the optional LMCI-100 USB programming adapter, or globally for many segment networks simultaneously utilizing standard BACnet/IP communication.

B. Additional parameters exposed through this method include but are not limited to:

1. Occupancy sensor detection LED disable for performance and other aesthetic spaces where blinking LEDs present a distraction.

2. Six occupancy sensor action behaviors for each controlled load, separately configurable for normal hours and after hours modes. Modes include: No Action, Follow Off Only, Follow On Only, Follow On and Off, Follow On Only with Override Time Delay, Follow Off Only with Blink Warn Grace Time, Follow On and Off with Blink Warn Grace Time.

3. Separate fade time adjustments per load for both normal and after hours from 0 - 4 hours.

4. Configurable occupancy sensor re-trigger grace period from 0 - 4 minutes separate for both normal hours and after hours.

5. Separate normal hours and after hours per-load button mode with modes including: Do nothing, on only, off only, on and off.

6. Load control polarity reversal so that on events turn loads off and vice versa.

7. Per-load DR (demand response) shed level in units of percent.

8. Load output pulse mode in increments of 1second.

9. Fade trip point for each load for normal hours and after hours that establishes the dimmer command level at which a switched load closes its relay to allow for staggered On of switched loads in response to a dimmer.

C. Generation of reports at the whole file, partial file, or room level. Reports include but are not limited to:

1. Device list report: All devices in a project listed by type.

2. Load binding report: All load controller bindings showing interaction with sensors, switches, and daylighting.

3. BACnet points report: Per room Device ID report of the valid BACnet points for a given site's BOM.

4. Room summary report: Device manifest for each room, aggregated by common BOM, showing basic sequence of operations.

5. Device parameter report: Per-room lists of all configured parameters accessible via hand held IR programmer for use with O&M documentation.
6. Scene report: All project scene pattern values not left at defaults (i.e. 1 = all loads 100%, 2 = all loads 75%, 3 = all loads 50%, 4 = all loads 25%, 5-16 = same as scene 1).
7. Occupancy sensor report: Basic settings including time delay and sensitivity(ies) for all occupancy sensors.

D. Network-wide programming of parameter data in a spreadsheet-like programming environment including but not limited to the following operations:
1. Set, copy/paste an entire project site of sensor time delays.
2. Set, copy/paste an entire project site of sensor sensitivity settings.
3. Search based on room name and text labels.
4. Filter by product type (i.e. LMRC-212) to allow parameter set by product.
5. Filter by parameter value to search for product with specific configurations.

E. Network-wide firmware upgrading remotely via the BACnet/IP network.
1. Mass firmware update of entire rooms.
2. Mass firmware update of specifically selected rooms or areas.
3. Mass firmware upgrade of specific products.

F. WattStopper Product Number: LMCS-100, LMCI-100

2.16 EMERGENCY LIGHTING CONTROL DEVICES

A. Emergency Lighting Control Unit – A UL 924 listed device that monitors a switched circuit providing normal lighting to an area. The unit provides normal ON/OFF control of emergency lighting along with the normal lighting. Upon normal power failure the emergency lighting circuit will close, forcing the emergency lighting ON until normal power is restored. Features include:
1. 120/277 volts, 50/60 Hz, 20 amp ballast rating
2. Push to test button
3. Auxiliary contact for remote test or fire alarm system interface

B. WattStopper Product Numbers: ELCU-100, ELCU-200.

PART 3 – EXECUTION

3.1 PRE-INSTALLATION MEETING

A. A factory authorized manufacturer's representative shall provide the electrical contractor a functional overview of the lighting control system prior to installation. The contractor shall schedule the pre-installation site visit after receipt of approved submittals to review the following:

1. Confirm the location and mounting of all digital devices, with special attention to placement of occupancy and daylighting sensors.

2. Review the specifications for low voltage control wiring and termination.

3. Discuss the functionality and configuration of all products, including sequences of operation, per design requirements.

4. Discuss requirements for integration with other trades.

3.2 CONTRACTOR INSTALLATION AND SERVICES

A. Contractor to install all devices and wiring in a professional manner. All line voltage connections to be tagged to indicate circuit and switched legs.

B. Contractor to install all room/area devices using manufacturer's factory-tested Cat 5e cable with pre-terminated RJ-45 connectors. If pre-terminated cable is not used for room/area wiring, the contractor is responsible for testing each field-terminated cable following installation, and shall supply the lighting controls manufactuerer with test results. Contractor to install any room to room network devices using manufacturer-supplied LM-MSTP network wire. Network wire substitution is not permitted and may result in loss of product warranty per DLM SEGMENT NETWORK section of specification. Low voltage wiring topology must comply with manufacturer's specifications. Contractor shall route network wiring as shown in submittal drawings as closely as possible, and shall document final wiring location, routing and topology on as built drawings.

C. Install the work of this Section in accordance with manufacturer's printed instructions unless otherwise indicated. Before start up, contractor shall test all devices to ensure proper communication.

D. Calibrate all sensor time delays and sensitivity to guarantee proper detection of occupants and energy savings.

1. Adjust time delay so that controlled area remains lighted while occupied.

E. Provide written or computer-generated documentation on the configuration of the system including room by room description including:

1. Sensor parameters, time delays, sensitivities, and daylighting setpoints.

2. Sequence of operation, (e.g. manual ON, Auto OFF. etc.)

3. Load Parameters (e.g. blink warning, etc.)

F. Post start-up tuning – After 30 days from occupancy contractor shall adjust sensor time delays and sensitivities to meet the Owner's requirements. Provide a detailed report to the Architect / Owner of post start-up activity.

3.3 FACTORY SERVICES

A. Upon completion of the installation, the manufacturer's factory authorized representative shall start up and verify a complete fully functional system.

B. The electrical contractor shall provide both the manufacturer and the electrical engineer with three weeks written notice of the system start up and adjustment date.

C. Upon completion of the system start up, the factory-authorized technician shall provide the proper training to the owner's personnel on the adjustment and maintenance of the system

D. Include a certified lighting control acceptance verified in writing by the factory authorized representative.

3.4 COMMISSIONING SUPPORT SERVICES

A. On this project, a commissioning agent will be hired to verify the installation and programming of all building systems, which includes the lighting control system. Manufacturer should include an extra day of technician’s time to review the functionality and settings of the lighting control hardware with the commissioning agent, including reviewing submittal drawings and ensuring that instructions on how to configure each device are readily available. Manufacturer is NOT responsible for helping the commissioning agent inspect the individual devices. It will be the commissioning agent’s responsibility to create and complete any forms required for the commissioning process, although the manufacturer or contractor may offer spreadsheets and/or printouts to assist the agent with this task.

B. The commissioning agent shall work with the electrical contractor during installation of the lighting control hardware to become familiar with the specific products. The agent may also accompany the manufacturer’s technicians during their start-up work to better understand the process of testing, calibration and configuration of the products. However, the contractor and manufacturer shall ensure that interfacing with the agent does not prevent them from completing the requirements outlined in the contract documents.

3.5 FINE TUNING AFTER SUBSTANTIAL COMPLETION

A. Provide a factory authorized representative for fine tuning and adjustments to the system within 6 months after substantial completion as coordinated and requested by the Owner. Modify and adjust controls, settings, and programming as directed by Owner.

END OF SECTION 26 09 23

SECTION 26 2200

LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:

1. Distribution transformers.

1.3 SUBMITTALS

A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.

C. Manufacturer Seismic Qualification Certification: Submit certification that transformers, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain each transformer type through one source from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

1.6 COORDINATION

A. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Products.
2. General Electric Company.
3. Square D; Schneider Electric.
4. Federal Pacific

2.2 GENERAL TRANSFORMER REQUIREMENTS

A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.

B. Cores: Grain-oriented, non-aging silicon steel.

C. Coils: Continuous windings without splices except for taps.

1. Internal Coil Connections: Brazed or pressure type.
2. Coil Material: Copper.

2.3 DISTRIBUTION TRANSFORMERS

A. Comply with NEMA ST 20, and list and label as complying with UL 1561.

B. Provide transformers that are constructed to withstand seismic forces specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

C. Cores: One leg per phase.

D. Enclosure: Ventilated, NEMA 250, Type 2.

E. Transformer Enclosure Finish: Comply with NEMA 250.

1. Finish Color: Gray.

F. Taps for Transformers Smaller Than 3 kVA: One 5 percent tap above normal full capacity.

G. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.

H. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.

I. Insulation Class: 220 deg C, UL-component-recognized insulation system.

1. 3 through 15 KVA shall be rated 115 degrees C rise. 30 KVA and larger shall be rated 150 degrees C rise.

J. Energy Efficiency for Transformers Rated 15 kVA and Larger:

1. Complying with NEMA TP 1, Class 1 efficiency levels.

2. Tested according to NEMA TP 2.

K. K-Factor Rating: Provide K-4 minimum rated transformers.

L. Wall Brackets: Provide manufacturer's standard wall mount bracket for transformers less than 30KVA.

M. Mounting: Mount transformers less than 30 KVA on wall above door as indicated in drawings.

N. Low-Sound-Level Requirements: Minimum of 3 dBA less than NEMA ST 20 standard sound levels when factory tested according to IEEE C57.12.91. Shall not exceed 45 dB.

2.4 IDENTIFICATION DEVICES

A. Nameplates: Engraved, laminated-plastic or metal nameplate for each transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Division 26 Section "Identification for Electrical Systems."

2.5 SOURCE QUALITY CONTROL

A. Test and inspect transformers according to IEEE C57.12.91.

B. Factory Sound-Level Tests: Conduct sound-level tests on equipment for this Project.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.

B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.

C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.

D. Verify that ground connections are in place and requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.

1. Brace wall-mounting transformers as specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems.

B. Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions, seismic codes applicable to Project, and requirements in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

3.3 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

C. Remove and replace units that do not pass tests or inspections and retest as specified above.

D. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.5 ADJUSTING

A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10

percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.

B. Output Settings Report: Prepare a written report recording output voltages and tap settings.

3.6 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION 26 22 00

SECTION 26 2413

SWITCHBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Service and distribution switchboards rated 600 V and less.
2. Transient voltage suppression devices, factory installed.
3. Disconnecting and overcurrent protective devices.
4. Instrumentation.
5. Control power.
6. Accessory components and features.
7. Identification.

B. Related Sections include the following:

1. Division 26 Section "Transient Voltage Suppression for Low-Voltage Electrical Power Circuits " for TVSS units that are factory-installed in switchboards.
2. Division 26 Section "Electricity Metering" for metering units that are installed in switchboards.
3. Division 26 Section “Switchboards and Integrated Low-Voltage Distribution and Controls

1.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Switchboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.4 SUBMITTALS

A. Product Data: For each type of switchboard, overcurrent protective device, transient voltage suppression device, ground-fault protector, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

B. Shop Drawings: For each switchboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.

2. Detail enclosure types for types other than NEMA 250, Type 1.

3. Detail bus configuration, current, and voltage ratings.

4. Detail short-circuit current rating of switchboards and overcurrent protective devices.

5. Include descriptive documentation of optional barriers specified for electrical insulation and isolation.

6. Detail utility company's metering provisions with indication of approval by utility company.

7. Include evidence of NRTL listing for series rating of installed devices.

8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

9. Include time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

10. Include schematic and wiring diagrams for power, signal, and control wiring.

C. Seismic Qualification Certificates: Submit certification that switchboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Field Quality-Control Reports:

1. Test procedures used.

2. Test results that comply with requirements.

3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

E. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Routine maintenance requirements for switchboards and all installed components.

2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

3. Time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.

B. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Comply with NEMA PB 2.

F. Comply with NFPA 70.

G. Comply with UL 891.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.

B. Remove loose packing and flammable materials from inside switchboards and to prevent condensation.

C. Handle and prepare switchboards for installation according to NEMA PB 2.1.

1.7 PROJECT CONDITIONS

A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.

B. Environmental Limitations:

1. Do not deliver or install switchboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above switchboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

a. Ambient Temperature: Not exceeding 104 deg F (40 deg C).

b. Altitude: Not exceeding 5000 feet (2000 m).

C. Service Conditions: NEMA PB 2, usual service conditions, as follows:

1. Ambient temperatures within limits specified.

2. Altitude not exceeding 5000 feet (2000 m).

D. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Engineer and Owner no fewer than seven days in advance of proposed interruption of electric service.

2. Indicate method of providing temporary electric service.

3. Do not proceed with interruption of electric service without Owner's written permission.

4. Comply with NFPA 70E.

1.8 COORDINATION

A. ALL EQUIPMENT SHALL BE COORDINATED WITH OWNER CUSTOM ELECTRICAL EQUIPMENT BUILDER, CPI. CONTRACTOR WILL BE REQUIRED TO COORDINATE WITH CPI FOR ALL EQUIPMENT REQUIRED TO BE FURNISHED BY CPI FOR THEM TO BUILD THE CUSTOM ENCLOSURES AND EQUIPMENT SKIDS. ONCE CUSTOM EQUIPMENT IS BUILT, THESE WILL BE SHIPPED TO THE SITE FOR INSTALLATION BY THE CONTRACTOR.

B. Coordinate layout and installation of switchboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces.

C. Maintain required workspace clearances and required clearances for equipment access doors and panels.

D. Coordinate with work of other trades so that piping, ductwork or any equipment foreign to the electrical installation is not located directly above switchboards.

E. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases.

1.9 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Potential Transformer Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.

2. Control-Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.

3. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

4. Indicating Lights: Equal to 10 percent of quantity installed for each size and type, but no fewer than one of each size and type.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Square D; a brand of Schneider Electric.

a. In coordination with CPI (Owner’s preferred custom enclosure builder)

B. Front-Connected, Front-Accessible Switchboards:

1. Main Devices: Fixed, individually mounted.

2. Branch Devices: Panel mounted.

3. Sections front and rear aligned.

C. Seismic Requirements: Fabricate and test switchboards according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

D. Indoor Enclosures: Steel, NEMA 250, Type 1.

E. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.

F. Outdoor Enclosures: Type 3R.

1. Finish: Factory-applied finish in manufacturer's standard color; undersurfaces treated with corrosion-resistant undercoating.

2. Enclosure: Downward, rearward sloping roof; bolt-on rear covers for each section, with provisions for padlocking.

G. Barriers: Between adjacent switchboard sections where normal power is required to be separate from emergency/life-safety power.

H. Customer Metering Compartment: A separate customer metering compartment and section with front hinged door, for indicated metering, and current transformers for each meter. Current transformer secondary wiring shall be terminated on shorting-type terminal blocks. Include potential transformers having primary and secondary fuses with disconnecting means and secondary wiring terminated on terminal blocks.

I. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.

J. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.

K. Pull Box on Top of Switchboard:

1. Adequate ventilation to maintain temperature in pull box within same limits as switchboard.

2. Set back from front to clear circuit-breaker removal mechanism.

3. Removable covers shall form top, front, and sides. Top covers at rear shall be easily removable for drilling and cutting.

4. Bottom shall be insulating, fire-resistive material with separate holes for cable drops into switchboard.

5. Cable supports shall be arranged to facilitate cabling and adequate to support cables indicated, including those for future installation.

L. Buses and Connections: Three phase, four wire unless otherwise indicated.

1. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity, with tin-plated copper feeder circuit-breaker line connections.

2. Load Terminals: Insulated, rigidly braced, runback bus extensions, of same material as through buses, equipped with mechanical connectors for outgoing circuit conductors. Provide load terminals for future circuit-breaker positions at full-ampere rating of circuit-breaker position.

3. Ground Bus: Minimum-size required by UL 891, hard-drawn copper of 98 percent conductivity, equipped with mechanical connectors for feeder and branch-circuit ground conductors. For busway feeders, extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.

4. Main Phase Buses and Equipment Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.

5. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with mechanical connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.

6. Lugs: Rated for copper only. CU-AL lugs are not allowed.

M. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.

2.2 SURGE PROTECTION DEVICES (SPD)

A. SPD Units: Comply with Division 26 Section "Surge Protection Devices."

B. Factory-installed, integral to switchboard within a segregated metal compartment that completely isolates the TVSS from the switchboard interior.

2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:

a. Instantaneous trip.

b. Long- and short-time pickup levels.

c. Long- and short-time time adjustments.

d. Ground-fault pickup level, time delay, and I^2t response.

4. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:

a. Standard frame sizes, trip ratings, and number of poles.

b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor material.

c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.

d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.

e. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.

B. For all circuit breaker overcurrent devices with frames rated 1200A or more, provide adjustable instantaneous time delay and interconnect into the arc energy reduction system.

C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

D. Fuses are specified in Division 26 Section "Fuses."

2.4 INSTRUMENTATION

A. Instrument Transformers: IEEE C57.13, NEMA EI 21.1, and the following:

1. Potential Transformers: IEEE C57.13; 120 V, 60 Hz, tapped secondary; disconnecting type with integral fuse mountings. Burden and accuracy shall be consistent with connected metering and relay devices.

2. Current Transformers: IEEE C57.13; 5 A, 60 Hz, secondary; bar or window type; double secondary winding and secondary shorting device. Burden and accuracy shall be consistent with connected metering and relay devices.

    a. CT's shall be dual wound rated with 50% and 100% taps. Metering shall be connected to the 50% tamp.

3. Control-Power Transformers: Dry type, mounted in separate compartments for units larger than 3 kVA.

4. Current Transformers for Neutral and Ground-Fault Current Sensing: Connect secondary wiring to ground overcurrent relays, via shorting terminals, to provide selective tripping of main and tie circuit breaker. Coordinate with feeder circuit-breaker, ground-fault protection.

B. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems integral with switchboard as indicated below:

    a. See 262713 Electricity Metering specification for approved Manufacturers

2. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.

3. Route ¾" conduit from meter to building cabletray for connection to building network and offsite monitoring.

4. Where current transformers are used, provide engraved label with 3/8"minimum high letters indicating CT ratio and multiplier. Attach label to electrical panel or meter base immediately below meter.

5. Provide CT's with 5 Amp secondary.

6. CT's shall be secured to MDP or transformer with appropriate brackets. Do not hang from secondary feeders.

7. Provide neutral CT in 3 Phase metering schemes.

8. Provide a Current Transformer Test Record for each CT which includes: Ratio; Ratio Correction Factor at 10% and 100% load; Serial Number; Date of Test.

9. Provide test block, fusing, CT's, ratio change, and shorting blocks per standard USU detail.

2.5 CONTROL POWER

A. Control Circuits: 120-V ac, supplied through secondary disconnecting devices from control-power transformer.

B. Control-Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.

C. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

2.6 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Portable Test Set: For testing functions of solid-state trip devices without removing from switchboard. Include relay and meter test plugs suitable for testing switchboard meters and switchboard class relays.

C. Spare-Fuse Cabinet: Suitably identified, wall-mounted, lockable, compartmented steel box or cabinet. Arrange for wall mounting.

2.7 ARC ENERGY REDUCTION SYSTEM

A. For each overcurrent device with a frame size of 1200A or higher, provide an arc energy reduction system complying with 2023 NEC 240.87.

B. System shall consist of an energy-reducing switch with local status indication. Status shall indicate whether the switch is on or off via illuminated blue LED indication lamp. Status indication shall be clearly and permanently marked.

C. Provide permanent label with instruction for operating the arc energy reduction system and warning that any coordination that has been designed into the system may not exist while the arc energy reduction system in “ON.”

D. When the arc energy reduction switch is turned “ON” (placed in the “ON” position), the system shall bypass the overcurrent protection device delay settings so that the time delay is “OFF” (0 seconds) and illuminate the switch “ON” indication lamp. When the arc energy reduction switch is turned “OFF” (placed in the “OFF” position), the system shall revert back to the standard overcurrent protection device settings and appropriate delay.

E. Provide all required components for a complete and fully functional arc energy reduction system.

2.8 IDENTIFICATION

A. Service Equipment Label: NRTL labeled for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

PART 3 - EXECUTION

3.1 APPLICATION

A. Circuit Breaker Types:

1. *Circuit Breakers 400A and larger: Solid-state, adjustable with LSI adjustments. For 480V circuit breakers 1000A and larger provide LSIG adjustments.*

2. *Circuit Breakers less than 400A: Molded case with instantaneous adjustments.*

3.2 EXAMINATION

A. Receive, inspect, handle, and store switchboards according to NEMA PB 2.1.

B. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.

C. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

A. Install switchboards and accessories according to NEMA PB 2.1.

B. Equipment Mounting: Install switchboards on concrete base, 4-inch (100-mm) nominal thickness. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete."

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.

2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.

3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

4. Install anchor bolts to elevations required for proper attachment to switchboards.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.

D. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

E. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.

F. Install filler plates in unused spaces of panel-mounted sections.

G. Install overcurrent protective devices, transient voltage suppression devices, and instrumentation.

1. Set field-adjustable switches and circuit-breaker trip ranges.

H. Install spare-fuse cabinet [within the vicinity of the building main switchboard.].

I. Comply with NECA 1.

3.4 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Acceptance Testing Preparation:

1. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit.

2. Test continuity of each circuit.

D. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

E. Switchboard will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as indicated.

3.7 PROTECTION

A. Temporary Heating: Apply temporary heat, to maintain temperature according to manufacturer's written instructions, until switchboard is ready to be energized and placed into service.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories, and to use and reprogram microprocessor-based trip, monitoring, and communication units.

END OF SECTION 26 24 13

SECTION 26 2416

PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.

B. Related Sections include the following:

1. Division 26 Section “Switchboards and Integrated Low-Voltage Distribution and Controls

1.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

1.4 SUBMITTALS

A. Product Data: For each type of panelboard, switching and overcurrent protective device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types and details for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Include evidence of NRTL listing for series rating of installed devices.
6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
7. Include wiring diagrams for power, signal, and control wiring.

8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

C. Seismic Qualification Certificates: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Field Quality-Control Reports:

1. Test procedures used.

2. Test results that comply with requirements.

3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

E. Panelboard Schedules: For installation in panelboards

F. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with NEMA PB 1.

E. Comply with NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.

B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.7 PROJECT CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

a. Ambient Temperature: Not exceeding minus 22 deg F (minus 30 deg C) to plus 104 deg F (plus 40 deg C).

b. Altitude: Not exceeding 5000 feet (2000 m).

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.

2. Altitude not exceeding 5000 feet (2000 m).

C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Engineer and Owner no fewer than two days in advance of proposed interruption of electric service.

2. Do not proceed with interruption of electric service without Engineer's and Owner's written permission.

3. Comply with NFPA 70E.

1.8 COORDINATION

A. ALL EQUIPMENT SHALL BE COORDINATED WITH OWNER CUSTOM ELECTRICAL EQUIPMENT BUILDER, CPI. CONTRACTOR WILL BE REQUIRED TO COORDINATE WITH CPI FOR ALL EQUIPMENT REQUIRED TO BE FURNISHED BY CPI FOR THEM TO BUILD THE CUSTOM ENCLOSURES AND EQUIPMENT SKIDS. ONCE CUSTOM EQUIPMENT IS BUILT, THESE WILL BE SHIPPED TO THE SITE FOR INSTALLATION BY THE CONTRACTOR.

B. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other

types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces.

C. Maintain required workspace clearances and required clearances for equipment access doors and panels.

D. Coordinate with work of other trades so that piping, ductwork or any equipment foreign to the electrical installation is not located directly above panelboards.

E. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.9 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Keys: Two spares for each type of panelboard cabinet lock.

2. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

B. Enclosures: Flush- and surface-mounted cabinets as indicated.

1. Rated for environmental conditions at installed location.

a. Indoor Dry and Clean Locations: NEMA 250, Type 1.

b. Outdoor Locations: NEMA 250, Type 3R.

c. Kitchen Areas: NEMA 250, Type 4X.

d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

2. Hinged Front Cover: Entire front trim hinged to box and with standard door within door cover.

3. Finishes:

a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.

b. Back Boxes: Galvanized steel.

4. Directory Card: Inside panelboard door, mounted in metal frame with transparent protective cover.

C. Incoming Mains Location: Top and bottom.

D. Phase, Neutral, and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.

2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.

3. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.

4. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.

E. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.

2. Lugs: rated for copper only.

3. Main and Neutral Lugs: Mechanical type.

4. Ground Lugs and Bus-Configured Terminators: Mechanical type.

5. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.

6. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

7. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.

F. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.

G. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

H. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

I. 208 Volt Panels- All 208 volt panels and distribution boards shall include both a bonded and insulated ground bus. The insulated ground bus is intended to provide an isolated ground system for sensitive equipment.

2.2 DISTRIBUTION PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Square D; a brand of Schneider Electric.

a. In coordination with CPI (Owner's preferred custom enclosure builder)

B. Panelboards: NEMA PB 1, power and feeder distribution type.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

1. For doors more than 36 inches (914 mm) high, provide two latches, keyed alike.

D. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.

E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

F. Branch Overcurrent Protective Devices: Fused switches.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Square D; a brand of Schneider Electric.

a. In coordination with CPI (Owner's preferred custom enclosure builder)

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

D. Doors: Door within door style. Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

E. Covers: Hinged front cover (door-in-door) type.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:

a. Instantaneous trip.

b. Long- and short-time pickup levels.

c. Long- and short-time time adjustments.

d. Ground-fault pickup level, time delay, and I^2t response.

4. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

5. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).

6. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:

a. Standard frame sizes, trip ratings, and number of poles.

b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.

c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.

d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.

e. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.

f. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.

g. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.

h. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

B. For all circuit breaker overcurrent devices with frames rated 1200A or more, provide adjustable instantaneous time delay and interconnect into the arc energy reduction system.

C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

1. Fuses, and Spare-Fuse Cabinet: Comply with requirements specified in Division 26 Section "Fuses."

2. Fused Switch Features and Accessories: Standard ampere ratings and number of poles.

3. Auxiliary Contacts: One normally open and normally closed contact(s) that operate with switch handle operation.

2.5 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

2.6 ARC ENERGY REDUCTION SYSTEM

A. For each overcurrent device with a frame size of 1200A or higher, provide an arc energy reduction system complying with 2023 NEC 240.87.

B. System shall consist of an energy-reducing switch with local status indication. Status shall indicate whether the switch is on or off via illuminated blue LED indication lamp. Status indication shall be clearly and permanently marked.

C. Provide permanent label with instruction for operating the arc energy reduction system and warning that any coordination that has been designed into the system may not exist while the arc energy reduction system in “ON.”

D. When the arc energy reduction switch is turned “ON” (placed in the “ON” position), the system shall bypass the overcurrent protection device delay settings so that the time delay is “OFF” (0 seconds) and illuminate the switch “ON” indication lamp. When the arc energy reduction switch is turned “OFF” (placed in the “OFF” position), the system shall revert back to the standard overcurrent protection device settings and appropriate delay.

E. Provide all required components for a complete and fully functional arc energy reduction system.

PART 3 - EXECUTION

3.1 APPLICATION

A. Circuit Breaker Types:

1. *Circuit Breakers 400A and larger: Solid-state, adjustable with LSI adjustments. For 480V circuit breakers 1000A and larger provide LSIG adjustments.*

2. *Circuit Breakers less than 400A: Molded case with instantaneous adjustments.*

3.2 EXAMINATION

A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.

B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.

C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

A. Install panelboards and accessories according to NEMA PB 1.1.

B. Equipment Mounting: Install floor-mounted panelboards on concrete bases, 4-inch (100-mm) nominal thickness. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete."

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of base.

2. For panelboards, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.

3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

4. Install anchor bolts to elevations required for proper attachment to panelboards.

5. Attach panelboard to the vertical finished or structural surface behind the panelboard.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

D. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

E. Mount top of trim 80 inches above finished floor unless otherwise indicated.

F. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

G. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.

H. Install filler plates in unused spaces.

I. Stub five 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub five 1-inch (27-GRC) empty conduits into raised floor space or below slab not on grade. Include pull strings in empty conduits.

J. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

K. Comply with NECA 1.

L. Fuse Selection and Installation: Verify connected load(s) and selection of fuse sizes for each disconnect switch prior to selection and installation.

3.4 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads and location in the building; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.

2. Test continuity of each circuit.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

D. Panelboards will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as indicated

END OF SECTION 26 24 16

SECTION 26 2713

ELECTRICITY METERING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Electricity meters.

B. Meters shall be connected to the Building Automation System (BAS) utilizing modbus protocol for building wide metering in compliance with the Utah State High Performance Building Standard requirements.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Dimensioned plans and sections or elevation layouts and wiring diagrams.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data. In addition to items specified in Section 01 7823 "Operation and Maintenance Data," include the following:

1. Application and operating software documentation.
2. Software licenses.
3. Software service agreement.
4. Hard copies of manufacturer's operating specifications, design user's guides for software and hardware, and PDF files on CD-ROM of the hard-copy Submittal.

1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.7 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning with Substantial Completion, provide software support for two years.

B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.

1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade his computer equipment if necessary.

1.8 COORDINATION

A. Electrical Service Connections:

1. Coordinate with utility companies and utility-furnished components.

a. Comply with requirements of utility providing electrical power services.

b. Coordinate installation and connection of utilities and services, including provision for electricity-metering components.

PART 2 - PRODUCTS

2.1 ELECTRICITY METERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide the following or prior approved equal.

1. Schneider Electric PM8000 Power Quality Meter

2. Other approved meters subject to compliance with requirements include the following and must meet BOD requirements:

a. Meter approved by CPI for custom enclosures

B. General Requirements for Electricity Meters:

1. Comply with UL 1244.

2. Meters shall meet or exceed accuracy in compliance with ANSI C12.20.

3. The meter shall support 3-Element Wye, 2.5 Element Wye, 2 Element Delta, 4 wire Delta systems.

4. The meter shall accept universal voltage input.

5. Meter shall be designed for operation with 60 HZ system.

6. The meter's surge withstand shall conform to IEEE C37.90.1.

7. The meter shall be user programmable for voltage range to any PT ratio.

8. The meter shall accept a burden up to 0.36VA per phase, Max at 600V, and 0.014VA at 120 Volts.

9. The meter shall accept a voltage input range of up to 300 Volts Line to Neutral, and up to 520 Volts Line to Line.

10. The meter shall accept a current reading of up to 11 Amps continuous.

11. The meter shall have color-coordinated voltage and current inputs.

12. The meter shall have a phasor diagram that clearly shows wiring status.

13. Enclosure: Where shown on plans. Type 1 where enclosure is required. Meter shall be installed integral with switchboard or panelboard when shown on plans.

14. Identification: Comply with requirements in Section 26 0553 "Identification for Electrical Systems."

15. Sensors: Current-sensing type, with current output, selected for optimum range and accuracy for meters indicated for this application.

16. Type: solid core or split core with ratio accuracy of at least +/- 1% full scale.

C. General Requirements for main service and main switchboard metering Electricity Meters:

1. Memory Backup: Unit shall have data-logging capability.

2. Provide sampling at 400+ samples per cycle on all channels measured readings simultaneously.

3. Meter shall provide Harmonics %THD (% of total Harmonic Distortion), including current, voltage, and power harmonics to the 63rd order harmonic.

D. General Requirements for sub metering Electricity Meters:

1. Memory Backup: Unit shall have 32 MB of memory/data-logging capability.

2. Provide sampling at 16+ samples per cycle on all channels measured readings simultaneously.

E. Kilowatt-hour/Demand Meter: Electronic three-phase meters, measuring electricity use and demand. Demand shall be integrated over a 15-minute interval.

1. Voltage and Phase Configuration: Meter shall be designed for use on circuits with voltage rating and phase configuration indicated for its application.

2. Display: LCD with characters not less than 0.25 inch (6 mm) high, indicating accumulative kilowatt-hours, current time and date, current demand, and historic peak demand. Retain accumulated kilowatt-hour and historic peak demand in a nonvolatile memory, until reset. The display shall be capable of displaying all

three phases simultaneously and have a selection button on the face of the meter to cycle through the measured parameters.

F. CT's shall be 5 amp secondary and shall be secured with appropriate brackets.

G. CT's shall be dual wound rated with dual taps at 50% and 100% rating. Meters shall be connected to 50% tap.

H. Provide neutral CT in all distribution systems where a neutral exists.

I. The meter shall have an accuracy of +/- 0.1% or better for volts and amps, and 0.2% for power and energy functions. The meter shall meet the accuracy requirements of IEC62053-22 (Class 0.2%) and ANSI C12.201(Class 0.2%).

1. The meter shall provide true RMS measurements of voltage, phase to neutral and phase to phase; current, per phase and neutral.

J. Meter shall be a traceable revenue meter, which shall contain a utility grade test pulse allowing power providers to verify and confirm that the meter is performing to its rated accuracy.

K. The main meter for each distribution voltage (both 480/277 and 208/120) shall include a test switch with inline fusing. Test switch shall be capable of access from the front of the switchboard without exposure to bus and main switchboard interior through a separate door or cover that only exposes the test switch and fusing.

1. Test block shall be equivalent to Milbank TS10-0111.

2. Provide inline fuse holder and fuses for between bus taps and meter test block.

3. Provide solid core CT's wherever possible.

L. Meter shall include 2 independent communications ports on the back and face plate, with advanced features.

1. One port, through backplate, shall be an RJ45 port, providing 100BaseT Ethernet communication speaking Modbus TCP, and a Web server.

2. The meter shall provide an optical IrDA port (through faceplate), as the second communication port, which shall allow the unit to be set up and programmed using a remote laptop PC without need for a communication cable.

M. The meter shall provide user configured fixed window or rolling window demand. This shall allow user to set up the particular utility demand profile.

1. Readings for kW, kVAR, kVA and PF shall be calculated using utility demand features.

2. All other parameters shall offer max and min capability over the user selectable averaging period.

3. Voltage shall provide an instantaneous max and min reading displaying the highest surge and lowest sag seen by the meter.

N. The meter shall support power supply of 90 to 265 Volts AC and 100 to 370 Volts DC. Universal AC/DC Supply shall be available.

1. Meter power supply shall accept burden of 10VA max.

2. Meter shall provide upgrade rate of 100msec for Watts, Var and VA. All other parameters shall be 1 second.

O. Communication: Meter shall have native MODBUS protocol.

1. Meter shall provide a minimum of 40 embedded MODBUS Objects consisting of standard voltage, current, and power parameters, including kW and kWH.

P. Communication: Meter shall have native Modbus TCP protocol.

1. Meter shall provide a minimum of 40 embedded Modbus Objects consisting of standard voltage, current, and power parameters, including kW and kWH. Objects shall be readily identifiable.

Q. Compatibility with other devices or systems: The electricity meter is intended to be a part of the building wide BAS. As such it is required to be fully compatible with the BAS. This requires that all the variables indicated in the schedule below can be accessed from the BAS.

R. Schedule of required electrical metering points:

S. Parameter (Metering Point)	T. Units
U. Energy Consumption	V. kWH
W. Real Power	X. kW
Y. Reactive Power	Z. kVAR
AA. Apparent Power	BB. kVA
CC. Power Factor	DD.
EE. Voltage, Line to Line	FF. Volts
GG. Voltage, Line to Neutral	HH. Volts
II. Current	JJ. Amps
KK. Real Power Phase A	LL. kW

MM. Real Power Phase B	NN. kW
OO. Real Power Phase C	PP. kW
QQ. Voltage Phase A-B	RR. Volts
SS. Voltage Phase B-C	TT. Volts
UU. Voltage Phase C-A	VV. Volts
WW. Voltage A-N	XX. Volts
YY. Voltage B-N	ZZ. Volts
AAA. Voltage C-N	BBB. Volts
CCC. Current Phase A	DDD. Amps
EEE. Current Phase B	FFF. Amps
GGG. Current Phase C	HHH. Amps
III. Present Demand (subinterval)	JJJ. kW
KKK. Present Demand	LLL. kW
MMM. Peak Demand	NNN. kW
OOO. Present Reactive Power (subinterval)	PPP. kVAR
QQQ. Present Reactive Power	RRR. kVAR
SSS. Peak Reactive Power	TTT. kVAR

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with all manufacturers equipment installation instructions.

B. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

C. Where current transformers are used, provide an engraved label with 3/8” minimum high letters indicating CT ratio and multiplier. Attach label to electrical panel or meter enclosure next to meter.

D. Provide a ¾” conduit from the meter to the nearest building telecomm room.

3.2 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Provide a current transformer test record for each CT which includes:

1. Ratio
2. Ratio correction factor at 10% and 100% load
3. Serial Number
4. Date of test

C. Tests and Inspections:

1. Verify proper operation and measurement of current transformers and document CT ratios for each electricity meter.
2. Verify proper operation and measurement of power meters. Provide calibration certificates to owner after start-up is completed.

D. Metering will be considered defective if it does not pass tests or inspections.

E. Document all settings for all metering devices and include with test and inspection reports.

F. Prepare test and inspection reports.

3.3 TRAINING

A. Provide a minimum of 2 hours of training for the Owners maintenance staff. Coordinate the time of this training with the owner at the time of project close-out.

END OF SECTION 26 27 13

SECTION 26 27 26
WIRING DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Snap switches.
B. Wall-box occupancy sensors.
C. Receptacles, receptacles with integral GFCI, and associated device plates.
D. Wall plates and covers.
E. Floor box service fittings.
F. Poke-through assemblies.
G. Wall box motion sensors.
H. Overfloor raceways.

1.02 RELATED REQUIREMENTS

A. Section 09 30 00 - Tiling.
B. Section 09 51 14 - Acoustical Panel Ceilings.
C. Section 09 54 23 - Linear Metal Ceilings.
D. Section 09 72 00 - Wall Coverings.
E. Section 09 91 00 - Painting.
F. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables: Manufactured wiring systems for use with access floor boxes with compatible pre-wired connectors.
G. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
H. Section 26 05 37 - Boxes for Electrical Systems.
I. Section 26 05 40 - Underfloor Ducts.
J. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
K. Section 26 09 23 - Lighting Control Devices: Devices for automatic control of lighting, including occupancy sensors, in-wall time switches, and in-wall interval timers.
L. Section 26 05 83 - Wiring Connections: Cords and plugs for equipment.

1.03 REFERENCE STANDARDS

A. FS W-C-596 - Connector, Electrical, Power, General Specification for; 2014h (Validated 2022).
B. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification); 2017g (Validated 2023).
C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
D. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2016.
E. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (Reaffirmed 2020).
F. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2021.
G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
H. UL 20 - General-Use Snap Switches; Current Edition, Including All Revisions.
I. UL 498 - Attachment Plugs and Receptacles; Current Edition, Including All Revisions.
J. UL 514D - Cover Plates for Flush-Mounted Wiring Devices; Current Edition, Including All Revisions.
K. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.
L. UL 1472 - Solid-State Dimming Controls; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the placement of outlet boxes with millwork, furniture, equipment, etc. installed under other sections or by others.
   2. Coordinate wiring device ratings and configurations with the electrical requirements of actual equipment to be installed.

3. Coordinate the placement of outlet boxes for wall switches with actual installed door swings.
4. Coordinate the installation and preparation of uneven surfaces, such as split face block, to provide suitable surface for installation of wiring devices.
5. Coordinate the core drilling of holes for poke-through assemblies with the work covered under other sections.

6. Notify Engineer of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

B. Sequencing:
1. Do not install wiring devices until final surface finishes and painting are complete.

1.05 SUBMITTALS

A. See Section 01 33 00 - Submittal Procedures, for submittal requirements.

B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.
1. Wall Dimmers: Include derating information for ganged multiple devices.
2. Overfloor Raceway: Include dimensioned layout with required components indicated.

C. Operation and Maintenance Data:
1. Wall Dimmers: Include information on operation and setting of presets.
2. GFCI Receptacles: Include information on status indicators.

D. Project Record Documents: Record actual installed locations of wiring devices.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Section 01 60 00 - Product Requirements, for additional provisions.
2. Screwdrivers for Tamper-Resistant Screws: Two for each type of screw.
3. Extra Keys for Locking Switches: Two of each type.
4. Extra Wall Plates: One of each style, size, and finish.
5. Extra Flush Floor Service Fittings: Two of each type.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Products: Listed, classified, and labeled as suitable for the purpose intended.

1.07 DELIVERY, STORAGE, AND PROTECTION

A. Store in a clean, dry space in original manufacturer's packaging until ready for installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers' Names: Shortened versions (shown in parenthesis) of the manufacturers' names are used in other Part 2 articles:
1. Cooper Wiring Devices; (Cooper): www.cooperindustries.com.
2. Hubbell Incorporated; (Hubbell): www.hubbell-wiring.com.
3. Leviton Manufacturing Company, Inc; (Leviton): www.leviton.com.
4. Lutron Electronics Company, Inc; (Lutron): www.lutron.com.
5. Pass & Seymour/Legrand; Wiring Devices & Accessories; (Pass & Seymour): www.legrand.us
6. Wattstopper, Inc; (Wattstopper): www.wattstopper.com.

B. Source Limitations: Where possible, provide products for each type of wiring device produced by a single manufacturer and obtained from a single supplier.

C. Source Limitations: Where wall controls are furnished as part of lighting control system, provide accessory matching receptacles and wallplates by the same manufacturer.

2.02 WIRING DEVICE APPLICATIONS

A. Provide wiring devices suitable for intended use and with ratings adequate for load served.

B. For single receptacles installed on an individual branch circuit, provide receptacle with ampere rating not less than that of the branch circuit.

C. Provide weather resistant GFCI receptacles with specified weatherproof covers for receptacles installed outdoors or in damp or wet locations.

D. Provide GFCI protection for receptacles installed within 6 feet (1.8 m) of sinks.

E. Provide GFCI protection for receptacles installed in kitchens.

F. Unless noted otherwise, do not use combination switch/receptacle devices.

G. For flush floor service fittings, use tile rings for installations in tile floors.
H. For flush floor service fittings, use carpet flanges for installations in carpeted floors.

2.03 WIRING DEVICE FINISHES

A. Provide wiring device finishes as described below unless otherwise indicated.
   1. Wiring Devices installed in tile: Refer to specification section 09 30 00 - Tiling.
   2. Wiring devices installed in acoustical panel ceilings: Refer to specification section 09 51 13 - Acoustical Panel Ceilings.
   3. Wiring devices installed in linear metal ceilings: Refer to specification section 09 54 23 - Linear Metal Ceilings.
   4. Wiring devices installed in vinyl covered walls: Refer to specification section 09 72 00 - Wall Coverings.
   5. Wiring devices installed in painted walls: Refer to specification section 09 91 00 - Painting.
   6. Wiring Devices installed on mirrors, granite, or slate, and in the kitchens, pool areas, and gymnasiums: Stainless steel faceplates with grey devices.
   7. Wiring devices installed in unpainted wood paneling or millwork: Brown devices and brown nylon coverplates.
   8. Wiring devices installed in unfinished areas: Galvanized steel faceplates with grey devices.
   9. Receptacles shutdown during fire alarm: Orange color.
B. Flush Floor Box Service Fittings: Refer to electrical drawings for finish.

2.04 WALL-BOX OCCUPANCY SENSORS

A. Wall-Switch Sensors (Type OS on plans)
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Wattstopper PW-301, set for manual on operation.
      b. Approved equal.
   2. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 180-degree field of view, with a major motion coverage area of 900 sq. ft.

2.05 WALL SWITCHES

A. Manufacturers:
   1. Hubbell Incorporated: www.hubbell-wiring.com.
   2. Leviton Manufacturing Company, Inc: www.leviton.com/#sle.
   3. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us/#sle.
   4. Cooper Wiring Devices; (Cooper): www.cooperindustries.com..
B. Wall Switches - General Requirements: AC only, quiet operating, general-use snap switches with silver alloy contacts, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 20and where applicable FS W-S-896; types as indicated on the drawings.
   1. Wiring Provisions: Terminal screws for side wiring and screw actuated binding clamp for back wiring with separate ground terminal screw.
C. Standard Wall Switches: Industrial specification grade, 20 A, 120/277 V with standard toggle type switch actuator and maintained contacts; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.
D. Momentary Contact Wall Switches: Industrial specification grade, 20 A, 120/277 V with toggle type three position switch actuator and momentary contacts; single pole double throw, off with switch actuator in center position.
E. Locking Maintained Contact Wall Switches: Low voltage maintained contact keyed switch mounted to switch plate by contractor. Key all switches alike.
   1. Products:
      a. Greengate MAIN-Key.

2.06 RECEPTACLES

A. Manufacturers:
   1. Hubbell Incorporated: www.hubbell-wiring.com.
   2. Leviton Manufacturing Company, Inc: www.leviton.com/#sle.
   3. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us/#sle.
   4. Cooper Wiring Devices; www.cooperindustries.com..

B. Receptacles - General Requirements: Self-grounding, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 498, and where applicable, FS W-C-596; types as indicated on the drawings.
   1. Wiring Provisions: Terminal screws for side wiring or screw actuated binding clamp for back wiring with separate ground terminal screw.
   2. NEMA configurations specified are according to NEMA WD 6.

C. Convenience Receptacles:
   1. Standard Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R; single or duplex as indicated on the drawings.
      a. Products:
   2. Automatically Controlled Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R; controlled receptacle marking on device face per NFPA 70; single or duplex as indicated on the drawings.
   3. Weather Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as weather resistant type complying with UL 498 Supplement SD suitable for installation in damp or wet locations; single or duplex as indicated on the drawings.
   4. Tamper Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type; single or duplex as indicated on the drawings.
   5. Tamper Resistant and Weather Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type and as weather resistant type complying with UL 498 Supplement SD suitable for installation in damp or wet locations; single or duplex as indicated on the drawings.

D. GFCI Receptacles:
   1. GFCI Receptacles - General Requirements: Self-testing, with feed-through protection and light to indicate ground fault tripped condition and loss of protection; listed as complying with UL 943, class A.
      a. Provide test and reset buttons of same color as device.
   2. Standard GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style.
   3. Weather Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as weather resistant type complying with UL 498 Supplement SD suitable for installation in damp or wet locations.
   4. Tamper Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as tamper resistant type.
   5. Tamper Resistant and Weather Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as tamper resistant type and as weather resistant type complying with UL 498 Supplement SD suitable for installation in damp or wet locations.

E. Locking Receptacles: Industrial specification grade, configuration as indicated on the drawings.

F. Clock Hanger Receptacles: Single, 15A, 125V, NEMA 5-15R.

2.07 Wall Plates and Covers

A. Manufacturers:
   1. Hubbell Incorporated: www.hubbell-wiring.com/#sle.
   2. Leviton Manufacturing Company, Inc: www.leviton.com/#sle.
   3. Lutron Electronics Company, Inc: www.lutron.com/#sle.
   4. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us/#sle.
   5. Cooper Wiring Devices; www.cooperindustries.com..

B. Wall Plates: Comply with UL 514D.

1. Configuration: One piece cover as required for quantity and types of corresponding wiring devices.
2. Size: Standard.
3. Screws: Metal with slotted heads finished to match wall plate finish.

C. Nylon Wall Plates: Smooth finish, high-impact thermoplastic.
D. Stainless Steel Wall Plates: Brushed satin finish, Type 302 stainless steel.
E. Galvanized Steel Wall Plates: Rounded corners and edges, with corrosion resistant screws.
F. Weatherproof Covers for Damp Locations: Gasketed, cast aluminum, with self-closing hinged cover and corrosion-resistant screws; listed as suitable for use in wet locations with cover closed.
G. Weatherproof Covers for Wet Locations: Gasketed, cast aluminum, with hinged lockable cover and corrosion-resistant screws; listed as suitable for use in wet locations while in use with attachment plugs connected and identified as extra-duty type.

2.08 FLOOR BOX SERVICE FITTINGS

A. Manufacturers:
1. Wiremold, a brand of Legrand North America, Inc: www.legrand.us/#sle.

B. Description: Service fittings compatible with floor boxes provided under Section 26 05 37 with components, adapters, and trims required for complete installation.
C. Flush Floor Service Fittings:
1. Dual Service Flush Combination Outlets:
a. Cover: As indicated on plans.
b. Configuration:
1) Power: As indicated on plans.
2) Communications: As indicated on plans.
2. Accessories:
a. Tile Rings: Finish to match covers; configuration as required to accommodate specified covers.
b. Carpet Flanges: Finish to match covers; configuration as required to accommodate specified covers.

2.09 POKE-THROUGH ASSEMBLIES

A. Manufacturers:
1. Wiremold, a brand of Legrand North America, Inc: www.legrand.us/#sle.
a. RC7 series.
2. Hubbell SystemOne, 2x2 series.
3. Steel City FPT3 series.
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: Assembly comprising floor service fitting, poke-through component, fire stops and smoke barriers, and junction box for conduit termination; fire rating listed to match fire rating of floor and suitable for floor thickness where installed.
C. Flush Floor Service Fittings:
1. Dual Service Flush Combination Outlets:
a. Cover: Slider access to power and data outlets.
b. Configuration:
1) Power: One standard convenience duplex receptacle(s).
2) Voice and Data Jacks: Refer to Division 27.
2. Accessories:
a. Closure Plugs: Size and fire rating as required to seal unused core hole and maintain fire rating of floor.

2.10 OVERFLOOR RACEWAYS

A. Manufacturers:
   1. Wiremold, a brand of Legrand North America, Inc: www.legrand.us.
      a. OFR Series Overfloor Raceway.
      b. Substitutions: Not allowed.

B. Overfloor Raceway:
   1. Description: Four-channel aluminum base with black powder coat finish, designed for installation directly to floor covering; furnished with removable tamper-resistant steel covers for installation of conductors and cables.
   2. Routing and Required Components: As indicated on plans.
   3. Components:
      a. Overfloor Raceway Base & Cover, #OFRBC-8.
      b. Overfloor Raceway Seam Clip, #OFR6.
      c. Overfloor Raceway Blank End Fitting, #OFR10B.
      d. Overfloor Raceway In-Wall Entrance End Fitting, #OFR10IW.
      e. Overfloor Raceway 4-Gang Box, #OFR48-4.
      f. OFR Crossover Kit, #OFR48-4GX.
      g. OFR Flat Elbow, #OFR11.
      h. OFR 45 Degree Flat Elbow, #OFR12.
      i. OFR Tee/Cross, #OFR15.
      j. OFR 3 Inch Poke-Thru Transition, #OFRPT3.
      k. OFR 4 Inch Poke-Thru Transition, #OFRPT4.
      l. OFR Coupling, #OFR1.
      m. OFR Grounding Clip, #OFR9.
      n. OFR Blank Device Plate, #OFR47-B.
      o. OFR Duplex Device Plate, #OFR47-D.
      p. OFR Communications Device Plate, #OFR47-2A.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.
B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.
C. Verify that wall openings are neatly cut and will be completely covered by wall plates.
D. Verify that final surface finishes are complete, including painting.
E. Verify that floor boxes are adjusted properly.
F. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.
G. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.
B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

A. Coordinate locations of outlet boxes provided under Section 26 05 37 as required for installation of wiring devices provided under this section.
   1. Orient outlet boxes for vertical installation of wiring devices unless otherwise indicated.
   2. Where multiple receptacles, wall switches, or wall dimmers are installed at the same location and at the same mounting height, gang devices together under a common wall plate, unless indicated otherwise.

3. Locate wall switches on strike side of door with edge of wall plate 3 inches (80 mm) from edge of door frame. Where locations are indicated otherwise, notify Engineer to obtain direction prior to proceeding with work.
4. Locate receptacles for electric drinking fountains concealed behind drinking fountain according to manufacturer's instructions.

B. Install wiring devices in accordance with manufacturer's instructions.
C. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
D. Where required, connect wiring devices using pigtails not less than 6 inches (150 mm) long. Do not connect more than one conductor to wiring device terminals.
E. Connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal and tightening to proper torque specified by the manufacturer. Where present, do not use push-in pressure terminals that do not rely on screw-actuated binding.
F. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
G. For isolated ground receptacles, connect wiring device grounding terminal only to identified branch circuit isolated equipment grounding conductor. Do not connect grounding terminal to outlet box or normal branch circuit equipment grounding conductor.
H. Unless otherwise indicated, GFCI receptacles may be connected to provide feed-through protection to downstream devices. Label such devices to indicate they are protected by upstream GFCI protection.
I. Where split-wired duplex receptacles are indicated, remove tabs connecting top and bottom receptacles.
J. Install wiring devices plumb and level with mounting yoke held rigidly in place.
K. Install wall switches with OFF position down.
L. Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.
M. Do not share neutral conductor on branch circuits utilizing wall dimmers.
N. Install vertically mounted receptacles with grounding pole on bottom and horizontally mounted receptacles with grounding pole on left.
O. Install wall plates to fit completely flush to wall with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.
P. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.
Q. Identify wiring devices in accordance with Section 26 05 53.
R. For overfloor raceways, install devices such that receptacles and low voltage outlets are mounted facing fitness equipment being served.
S. For fitness equipment receptacles, do not share neutral conductors or ground conductors across multiple circuits.

3.04 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.
B. Inspect each wiring device for damage and defects.
C. Operate each wall switch and wall dimmer with circuit energized to verify proper operation.
D. Test each receptacle to verify operation and proper polarity.
E. Test each GFCI receptacle for proper tripping operation according to manufacturer's instructions.
F. Correct wiring deficiencies and replace damaged or defective wiring devices.

3.05 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

B. Adjust presets for wall dimmers according to manufacturer's instructions as directed by Engineer.

3.06 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

END OF SECTION

SECTION 26 2813

FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Cartridge fuses rated 600-V ac and less for use in control circuits, enclosed switches, panelboards, switchboards, enclosed controllers and motor-control centers.

2. Spare-fuse cabinets.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:

1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.

a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.

b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.

2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.

3. Current-limitation curves for fuses with current-limiting characteristics.

4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.

5. Coordination charts and tables and related data.

6. Fuse sizes for elevator feeders and elevator disconnect switches.

B. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Ambient temperature adjustment information.

2. Current-limitation curves for fuses with current-limiting characteristics.

3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.

4. Coordination charts and tables and related data.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA FU 1 for cartridge fuses.

D. Comply with NFPA 70.

E. Comply with UL 248-11 for plug fuses.

1.5 PROJECT CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F (5 deg C) or more than 100 deg F (38 deg C), apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.6 COORDINATION

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

1.7 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Bussmann, Inc.

2. Edison Fuse, Inc.

3. Ferraz Shawmut, Inc.

4. Littelfuse, Inc.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

2.3 SPARE-FUSE CABINET

A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.

1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.

2. Finish: Gray, baked enamel.

3. Identification: "SPARE FUSES" in 1-1/2-inch- (38-mm-) high letters on exterior of door.

4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

2.4 MECHANICAL EQUIPMENT

A. Provide current limiting fuses on all large mechanical equipment rated 60 Amps and above to reduce fault current values at equipment to below 5,000 AIC.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

A. Cartridge Fuses:

1. Feeders: Class J, time delay.

2. Motor Branch Circuits: Class RK5, current limiting, time delay.

a. Confirm with manufacturer cutsheets.

3. Elevator Branch Circuits: Class RK1 or RK5, current limiting, time delay.

a. Confirm with manufacturer cutsheets.

4. Other Branch Circuits: Class J, time delay.

5. Control Circuits: Class CC, time delay.

3.3 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

B. Fuse Selection and Installation: Verify connected load(s) and selection of fuse sizes for each disconnect switch prior to selection and installation.

C. Install spare-fuse cabinet(s). Locate in the vicinity of the building main distribution panel.

3.4 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 26 28 13

SECTION 26 2816

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Shunt trip switches.
4. Molded-case circuit breakers (MCCBs).
5. Molded-case switches.
6. Enclosures.
7. Elevator Power Module Shunt-Trip Fused Disconnects

1.3 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

1.5 SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current ratings (interrupting and withstand, as appropriate).

4. Include evidence of NRTL listing for series rating of installed devices.

5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.

6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

C. Seismic Qualification Certificates: For enclosed switches and circuit breakers, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Field quality-control reports.

1. Test procedures used.

2. Test results that comply with requirements.

3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

E. Manufacturer's field service report.

F. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.

2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with NFPA 70.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).

2. Altitude: Not exceeding 6600 feet (2010 m).

B. Comply with NFPA 70E.

1.8 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.9 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

2. Fuse Pullers: Two for each size and type.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.

3. Siemens Energy & Automation, Inc.

4. Square D; a brand of Schneider Electric.

B. Type HD, Heavy Duty, Single Throw, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

1. All lugs shall be rated copper only.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.

2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.

3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.

4. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.

5. Hookstick Handle: Allows use of a hookstick to operate the handle.

6. Lugs: Mechanical type, suitable for number, size, and conductor material.

7. Service-Rated Switches: Labeled for use as service equipment.

2.2 NONFUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.

3. Siemens Energy & Automation, Inc.

4. Square D; a brand of Schneider Electric.

B. Type HD, Heavy Duty, Single Throw, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

1. All lugs shall be rated copper only.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.

2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.

3. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.

4. Hookstick Handle: Allows use of a hookstick to operate the handle.

5. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.3 MOLDED-CASE CIRCUIT BREAKERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

D. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

E. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:

1. Instantaneous trip.
2. Long- and short-time pickup levels.
3. Long- and short-time time adjustments.
4. Ground-fault pickup level, time delay, and I^2t response.

F. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

G. Ground-Fault, Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).

H. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
5. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.

6. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.

2.4 MOLDED-CASE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. General Requirements: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.

C. Features and Accessories:

1. Standard frame sizes and number of poles.
2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
3. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic switch contacts, "b" contacts operate in reverse of switch contacts.

2.5 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R.
3. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

2.6 ELEVATOR SHUNT-TRIP FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Bussmann, Inc. - Power Module PS

B. Provide shunt-trip fused disconnect switch with all necessary relay(s), control transformer and other options, as shown on drawings and listed below:

1. Ampere rating of the switch shall be based upon the elevator manufacturer requirements.
2. Short-circuit current rating of 200,000A.

3. Interlocks to prevent the opening of the cover when the switch is in the ON position. Interlock shall be defeatable for testing purposes.

4. Handle lockable in OFF position.

5. 100VA/120V control power transformer with primary and secondary fuses.

6. Isolation relay (3PDT, 10amp, 120V). A normally open dry contact shall be provided by the Fire Alarm Safety System to energize the isolation relay and activate the shunt trip solenoid (140VA inrush at 120V). (Note: if 24V DC coil is selected, a separate 24V DC source and contact must be provided by the Fire Alarm Safety System.)

7. Provide additional options as indicated below:

    a. Key to Test Switch

    b. “On” Pilot Light (Green, Red or White)

    c. Isolated Full Capacity Neutral Lug

    d. 1P NC Mechanical Interlock (required for hydraulic elevators with automatic recall).

    e. Fire Alarm Voltage Monitoring Relay (Comply with NFPA 72)

    f. NEMA 1 Enclosure.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Install fuses in fusible devices. Verify connected load(s) and selection of fuse sizes for each disconnect switch prior to selection and installation.

E. Location: Equipment disconnecting means shall be immediately next to the equipment which it services.

F. Comply with NECA 1.

3.3 IDENTIFICATION

A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.

2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.

2. Test continuity of each circuit.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges.

END OF SECTION 26 28 16

SECTION 26 2901

SWITCHBOARDS AND INTEGRATED LOW-VOLTAGE DISTRIBUTION AND CONTROLS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Equipment purchased by Division 26 contractor from Integrated Panel Manufacturer.

1. All equipment necessary for low voltage power distribution, motor control, centralized lighting control, and emergency egress lighting power.

2. Includes: switchboards, panelboards, transformers, circuit breakers, lighting contactors, timeclock, photocell, motor controllers, emergency uninterruptible power supply, and loose disconnects.

1.2 RELATED REQUIREMENTS

A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified.

2. Refer to Section 26 05 48 - Vibration and Seismic Controls for Electrical Systems for seismic bracing requirements.

B. Section 01 40 00 - Quality Requirements.

C. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.

D. Section 26 05 26 - Grounding and Bonding for Electrical Systems.

E. Section 26 05 34 - Conduit for Electrical Systems.

F. Section 26 05 37 - Boxes for Electrical Systems.

G. Section 26 05 73 - Power System Studies.

1.3 ABBREVIATIONS AND ACRONYMS

A. CPI: Carolina Products, Inc.

B. EPO: Emergency power off.

C. HOA: Hand/Off/Auto.

D. I/O: Input/Output.

E. IPM: Integrated Panel Manufacturer.

1.4 REFERENCE STANDARDS

A. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

B. IEC 60947-1: General Applicable Rules for Standard utilizations Categories

C. IEC 60947-2: Circuit Breakers.

D. IEC 60947-3: Isolating Devices.

E. IEC 60947-4-1: Contactors and Motor Starters.

F. IEC 60947-5-1: Control and Signaling Units.

G. IEC 60947-6-2: Control and Protection Devices.

H. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2008.

I. NEMA PB 1 - Panelboards; National Electrical Manufacturers Association; 2006.

J. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less; National Electrical Manufacturers Association; 2007.

K. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.

L. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.

M. UL 67 - Panelboards; Current Edition, Including All Revisions.

1.5 SUBMITTALS

A. See 01 33 00 - Submittal Procedures.

B. IPM shall prepare product data and shop drawings for Division 26 contractor and Engineer's review required.

1. Product Data: Provide manufacturer's standard catalog pages and data sheets for switchboards, lighting inverters, overcurrent protective devices, and other installed components and accessories.

2. Shop Drawings: for each type of switchgear, integrated panel, and related equipment.

a. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.

b. Provide wiring diagrams for power, signal, and control wiring clearly indicating factory wiring and required field wirings.

c. Include documentation demonstrating selective coordination.

C. Operation and Maintenance data. Provide as specified under "Administrative Requirements" or under "Operation and Maintenance" section, whichever is more stringent.

1.6 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements listed below.

B. Comply with requirements of NFPA 70.

C. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

D. Electrical components, devices, and accessories shall be UL listed and approved, and final assemblies shall have a serialized UL label for entire enclosed assembly.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).

2. Altitude: Not exceeding 5000 feet (2010 m).

B. Comply with NFPA 70E.

1.9 COORDINATION

A. IPM to coordinate features of devices specified in this Section with systems and components specified in other Sections to form an integrated system of compatible components. Match components and interconnections for optimum performance of specified functions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design Manufacturer: CPI

1. Contact: Matt Hoffman, (704) 776-6924, matth@cpipanels.com. Adam Worth: (704)-264-9029, adamw@cpipanels.com.

B. Alternate manufacturers will be considered with prior approval. Full design drawings indicating field and factory wiring requirements, control components used, component interlocks, and equipment room layouts showing all equipment footprints and clearances must be submitted as part of the approval process.

2.2 MANUFACTURED UNITS FOR POWER AND CONTROL DISTRIBUTION

A. Includes Square D Switchboard, overall service size and rated fault withstand current as indicated on the plans. Include customer demand metering as per the utility requirements.

1. Selectivity: Where selectivity is required per specifications, furnish products as required to achieve selective coordination.

2. Arc Flash Energy-Reducing Maintenance Switching: For circuit breakers rated 1200 A or higher, provide a local accessory switch with status indicator light that permits selection of a maintenance mode with alternate electronic trip unit settings for reduced fault clearing time.

B. Circuit Breakers:

1. Interrupting Capacity:

a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than specified minimum requirements.

b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.

2. Molded Case Circuit Breakers:

a. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers; listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.

1) Provide thermal magnetic circuit breakers, unless otherwise indicated.

2) Provide electronic trip circuit breakers for circuit breakers rated 800 A and larger and for all breakers serving emergency systems and elevators.

b. Minimum Interrupting Capacity:

1) 10,000 rms symmetrical amperes at 208 VAC.

2) 14,000 rms symmetrical amperes at 480 VAC.

c. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.

1) Provide field-adjustable magnetic instantaneous trip setting for circuit breaker frame sizes 225 A and larger.

2) Provide interchangeable trip units for circuit breaker frame sizes 225 A and larger.

d. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units.

1) Provide the following field-adjustable trip response settings:

a) Long time pickup, adjustable by setting dial.

b) Long time delay.

c) Short time pickup and delay.

d) Instantaneous pickup.

e) Ground fault pickup and delay where ground fault protection is indicated.

C. Loose stepdown transformers with efficiencies as required per current standards and loose motor disconnects of size and fault current withstand as indicated on the plans.

D. Enclosure(s):

1. Material: Bare Aluminum, NEMA 1 rated.

2. Final Assembly shall bare a serialized UL 508 label.

3. Size: As required per plans indicating locations, footprint limitations with power and controls functions as indicated.

4. Panel front door shall be cut out to allow operation of all circuit breakers, hand switches and miscellaneous other devices without exposure to live components.

5. Enclosure shall have an open bottom and closed top.

6. Standard 84 in. height doors shall have at least 3 lift-out hinges and at least 2 quarter-turn, quick release, cam-lock fasteners opposite the hinge side for securing door closed.

7. Spacing between internal mounted components shall, at minimum, meet the required clearances per NEC.

8. Panels shall have separate lockable cover over each circuit breaker operator access panel.

E. Surface-mounted Pilot Lights, Push Buttons and Selector Switches:

1. Physical Characteristics:

a. Size: 30.5 mm.

b. Rating: NEMA 1/4/12/13; IEC 529 IP66/65

2. Pilot Lights:

a. Power Source Modification: 120VAC or higher requires integral step-down transformer; Maximum voltage at the lamp: 24V.

b. Lamp/bulb: LED high intensity -- easily recognized "on-state" under typical indoor room illumination levels.

c. Colors: green = equipment "on/running"; red = "off"; orange/amber = "fault/failure".

3. Push Buttons and Selector Switches:

a. Contact Ratings:

1) Utilization Categories: NEMA A600 / IEC AC-15

2) 120 - 600Vac: 7200VA make; 720VA break.

3) 72 -120Vac: 60A make; 720VA break

4) 24 - 72Vac: 60A make; 10A break.

5) Maximum continuous current: 10A(ac).

4. Other Miscellaneous Surface-Mounted Devices

a. Nameplates/Labels.

1) Machine printed permanent black ink or engraved bi-layer phenolic plastic; black surface with white lettering.

2) Protected from degradation due to accidental water splash.

3) Text size: Major Equipment: 1/2"H, Small Devices 3/16"H.

F. Interior Mounted Components.

1. All Panelboards.

a. Provide products listed and labeled by Underwriters Laboratories Inc. as suitable for the purpose indicated.

b. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:

1) Altitude: Less than 6,600 feet (2,000 m).

2) Ambient Temperature:

a) Panelboards containing Circuit Breakers: 32 - 104 F.

c. Short Circuit Current Rating:

1) Provide panelboards with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.

d. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.

e. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.

f. Bussing: Sized in accordance with UL 67 temperature rise requirements.

1) Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.

g. Conductor Terminations: Suitable for use with the conductors to be installed.

h. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.

1) Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:

2) Boxes: Galvanized steel unless otherwise indicated.

a) Provide wiring gutters sized to accommodate the conductors to be installed.

3) Fronts:

a) Where mounted as assemblies inside an overall enclosure, provide open frame plus circuit breaker cover plate. Provide spacers to provide secure fit when assembly door is closed.

b) Finish for Painted Steel Fronts: Manufacturer's standard grey unless otherwise indicated.

i. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.

j. Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with UL 1053.

1) Where electronic circuit breakers equipped with integral ground fault protection are used, provide separate neutral current sensor where applicable.

2) Where accessory ground fault sensing and relaying equipment is used, equip companion overcurrent protective devices with ground-fault shunt trips.

a) Use zero sequence ground fault detection method unless otherwise indicated.

b) Provide test panel and field-adjustable ground fault pick-up and delay settings.

k. Multi-Section Panelboards: Provide enclosures of the same height, with feed-through lugs or sub-feed lugs and feeders as indicated or as required to interconnect sections.

l. Load centers are not acceptable.

2. Combination Motor Starters Conforming to IEC and UL508

a. Utilization category: AC-3.

b. Coordination required: Type 2.

c. Combination Motor Starter configuration (circuit breaker, contactor & overload) must be a UL listed combination for the Short Circuit Current Rating (SCCR) as shown on the plans. See Website:

http://www.ul.com/global/eng/pages/offerings/industries/powerandcontrols/industrialcontrolequipment/shortcircuit/

d. Acceptable Manufacturers for Combination Motor Starters:

1) Square D TeSys for the North American Market; No Substitutions

3. Lighting Contactors

   a. Utilization Category: AC-1.

   b. Coordination required: Type 1.

   c. Combination circuit breaker and contactor must be a UL listed combination for the Short Circuit Current Rating (SCCR) as shown on the plans. See Website:

      http://www.ul.com/global/eng/pages/offerings/industries/powerandcontrols/industrialcontrol equipment/shortcircuit/

   d. Acceptable Manufacturers for lighting assemblies: Square D TeSys for the North American Market; No Substitutions.

4. Small Size, 6-pulse Component Variable Frequency Drives (1/2 to 25 HP)

   a. Equipment Name(s)/Tagname(s): see schedules for information.

   b. Power Input Options: with 5% line choke, see schedules for information.

   c. Power Output Options: see schedules for information.

   d. Motor Size(s): see schedules for information.

   e. Output wiring from drive to motor: specific purpose shielded cable required, see "Low Voltage Electrical Power Conductors and Cables".

   f. VFD size selected for each application shall be based on the motor current as per NFPA 70, Table 430.250 or motor nameplate data, whichever is the greatest.

   g. Load carrying capacity: Continuous at 100% load, 150% for 60s (every 10 min), 180% for 2s (every 10 min).

   h. Output frequency: 0 to 120 Hz minimum.

   i. Output carrier frequency: programmable 5 to 10 kHz.

   j. Drive interface requirements:

      1) VFD shall contain the minimum built-in standard configurations to operate as described herein:

         a) Drive output to motor shall be selectable to either V/Hz or Sensorless Vector scheme. V/Hz characteristic curve shall be adjustable.

         b) The drive shall have an integral start/stop device, and speed control knob, such that a power interruption, and subsequent return to power, will cause the drive to restart automatically and ramp up to the speed setting set by the speed control knob, if in fact, it was previously operating at the time of power interruption. If the drive was off at the time of power interruption, it will remain off on return of power.

c) The drive shall have the minimum capabilities (via hardwired I/O) for remote start/stop and speed control, such that a power interruption, and subsequent return to power, will cause the drive to restart automatically and ramp up to the speed setting as determined by remote unpowered sources such as momentary start & stop push buttons and a potentiometer, if in fact, it was previously operating at the time of power interruption. If the drive was off at the time of power interruption, it will remain off on return of power.

d) The drive shall have all the functions as stated in above items "a & b" plus an Integral remote/local switch, such that a power interruption, and subsequent return to power, will cause the drive to restart in its previous mode (local or remote) and ramp back up to speed based on the previous setting (local or remote).

e) When the drive has a fault, a dry relay contact shall close for remote indication of status and be capable of at least 120Vac at 2A resistive.

f) If the drive fails to start, provide configurable parameter for number of retries before setting the "fault" status.

g) The drive shall have an embedded PID function and the I/O to provide such functions as remote (and local) start/stop and HOA hardwired switches and speed control based on a process set point.

h) The drive shall contain communications interconnection and sufficient I/O whereby the following minimum features can be viewed and controlled via local, remote hardwired and remote communications.

i) Communications protocol required: RS485 (modbus RTU), Ethernet/IP, or DeviceNet. NOTE: if a particular manufacturer cannot the communications protocol specified, the manufacturer may submit on the next best drive line that can supply this protocol or provide the necessary adapter, plus power required to that adapter and an enclosure that meets the rating where the drive will be installed.

2) Hardwired I/O:

a) Analog Input(s): 2 - configurable/programmable unipolar either 0-10Vdc or 4-20mA.

b) Analog Output(s): 1 - configurable/programmable.

c) Digital Input(s): 3 - as sensed by remote dry contacts

d) Digital Output(s): 1 - dry contact for indication of: ready/fault status. Minimum contact rating of switching voltage up to 120Vac and minimum resistive current of 2A.

3) Minimum Operational Programmable Features:

a) Current limit: 0 - 200%.

b) Overload Class Protection: Class 10.

c) Acceleration Time.

d) Deceleration Time.

e) All inputs' and outputs' functions and configurations.

4) Operator Interface: at minimum integral one line LCD display with membrane buttons for navigation, start/stop and speed control capable of being mounted remotely from the drive, up to 15', and be capable of uploading the drive's configuration parameters to be downloaded to another.

k. Ambient Environment

1) Operating temperature: 0 to 40°C (32 to 104°F), no frost, non-condensing.

2) Location: Indoors exposed.

3) Required drive enclosure rating: IP20/ NEMA/UL Type 0. NOTE: if a particular manufacturer cannot meet the enclosure rating required, this manufacturer shall provide an enclosure which can meet the requirement, and in addition, provide a cooling system so that the drive can function in the ambient environment specified.

4) Physical Mounting: wall mount.

5) Public Exposure: limited access to unskilled operators.

l. Acceptable Manufacturers

1) Square D Altivar 312 series.

2) No Substitutions.

5. VFD Input Line Reactors

a. Designed for specifically for harmonic filtering service.

b. Maximum Operating Temperature: 40 C.

c. Ambient Humidity operating limits: 0 - 95% non-condensing.

d. Impedance: 5%

e. Basic Construction: copper wire wound on magnetic steel core.

1) Copper windings shall be wire or foil.

2) Core shall be constructed of laminated, grain-oriented, magnetic steel; grade M6 or better.

f. Assembly

1) Completed inductors shall be double-impregnated using 100% solid epoxy resin.

2) All insulation varnish systems shall be rated Class H, 600V.

3) Inductors shall be air-gapped to avoid control point saturation.

g. Quality Assurance

1) Inductors shall be Hi-Potential tested (at 2,500 V, 60 Hz) for one minute both all line-to-line and line-to-ground connections.

2) UL component-recognized and built to comply with UL508A standards.

h. Acceptable Manufacturers

1) Trans-coil Inc. KDR or KLR series.

2) MTE RL-Line Load Reactors.

3) Or Equal.

6. Programmable Logic Controller (PLC) System

a. PLC Assembly shall have at least one analog input and multiple dry contact relay outputs to accept a photocell input and energize corresponding outputs depending on daylight intensity. At minimum, programming shall include operator adjustable set points for each relay output determined by daylight intensity on a scale 0 to 10.

b. At minimum, analog input(s) shall accept +/-10Vdc signal with a minimum impedance of 100kΩ and are allowed to share a common (single-ended). Resolution shall be -32,000 to +32,000.

c. At minimum analog output(s) shall be configurable as 0-10V into impedance >= 5kΩor 0-20mA into 500 Ω maximum load.

d. Digital inputs shall be field configurable as sinking or sourcing, 24 Vdc maximumsupply voltage.

e. Digital outputs shall be dry contact relay type capable of switch voltage of from 5 to30Vdc or 5 to 250Vac at 2.0A maximum. Up to 4 dry contacts are allowed to be on one common return/neutral; total common current not to exceed 10A.

f. PLC System shall be able to control an additional 7- I/O modules within a limited power budget depending on types of expansion modules used. Control panel layout shall leave at least 12" for future I/O module installations.

g. The PLC shall also provide at least 2 digital communication ports; one for an Electronic Operator Interface (EOI) and one for connection to a PC/laptop for maintenance, programming and troubleshooting.

h. PLC system shall have a modem connection to a standard analog telephone line for remote troubleshooting and maintenance.

i. Electronic Operator Interface (EOI) shall be included and programmed to perform basic operator input and status of controlled equipment. EOI may be monochrome, and be at least 5.5" diagonal size.

j. Entire system as described herein shall be a single source manufacturer and shall be a Siemens Simatic S7-200 series with compatible expansion modules, modem and EOI as described herein.

2.3 REMOTE HOA PANEL

A. Manufacturer: IPM.

B. Refer to drawings for enclosure quantity, location(s), and control information.

C. Enclosure:

1. Size: 16"x16"x6" or as required per plans indicating location, footprint limitiations with power and control functions as indicated.

2. Material: NEMA 4X construction.

3. Door Latches: non-metallic except for hasp and pin which are to be 316L stainless steel.

D. Door-mounted Components:

1. Push Buttons and Selector Switches:

a. 22mm hand/off/auto switches in quantity required for control of pool pumps.

1) Hand position bypasses control and runs continuously.

2) Auto position runs based on control status only.

b. 120V maintained switch positions.

2. Pilot Lights:

a. Voltage: 120V pilot light to indicate operation.

b. Colors:

1) Green: Equipment on/running.

2) Red: Equipment off.

3) Orange/Amber: Fault/failure.

3. Internal Components:

a. Terminal strips for field connections between HOA panel and associated integrated panel.

2.4 STEAM GENERATOR CONTROL PANEL

A. A. Manufacturer: IPM.

B. Refer to drawings for enclosure quantity, location(s), and control information.

C. Enclosure:

1. Size: 18"x18"x6" or as required per plans indicating location, footprint limitiations with power and control functions as indicated.

2. Material:

a. Non-Corrosive Environments: bare aluminum NEMA 1 construction.

b. Corrosive Environments: 16"x16"x6" NEMA 4X construction.

D. Internal Components:

1. Honeywell thermostat programmed by IPM for dual setpoint temperature control.

a. Setpoint 1 for solenoid 1: 115 degrees Fahrenheit interlocked with eucalyptus pump.

b. Setpoint 2 for solenoid 2: 110 degrees Fahrenheit.

2. Time delay relay programmed by IPM for 15-minute steam demand.

3. QOU115 circuit breaker for 120V control power.

4. Terminal strip for field connection of steam generator solenoids, temperature sensor, and pushbutton for steam demand.

E. Loose Components for Field Installation:

1. Normally closed maintained contact EPO for emergency shutdown of steam generator. Refer to drawings for quantity, location(s), and model number specification.

2. Normally open momentary contact pushbutton for steam demand. Refer to drawings for quantity and location(s).

2.5 EMERGENCY UNINTERRUPTIBLE POWER SUPPLY (UPS)

A. Description: NFPA 111 Type A, Class 1.5 stored emergency power supply system designed for Level 1 applications and consisting of rectifier/charger unit, storage battery, and solid state inverter with mechanical transfer switch, in one or several enclosures. Provide unit suitable for operating LED lamps without extinguishing lamp on transfer.

B. Ratings: As indicated on the drawings. Unit shall be capable of supplying 100% of the indicated kVA, at 1.0 power factor, for 90 minutes.

2.6 POWER MONITORING EQUIPMENT

A. Customer meter to be as specified on plans, furnished factory installed in MSB as part of the IPM package, meter wiring by Division 26 contractor.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protection from in-place conditions until startup.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Control Wiring Installation:

1. Wiring Method: Install all wiring in raceway as specified in 26 05 34 and 26 05 37, unless run in accessible ceiling space.

2. Bundle, train, and support wiring in enclosures.

3. Ground equipment.

3.3 FIELD QUALITY CONTROL

A. Provide manufacturer's field representative to set up test, adjust, and program dimming controls.

B. Schedule visual and mechanical inspections and electrical tests with at least seven days advanced notice.

C. Inspect control components for defects and physical damage, testing laboratory labeling, and nameplate compliance with the contract documents.

D. Check tightness of electrical connections with torque wrench calibrated within the previous 6 months. Use manufacturer's recommended torque values.

E. Electrical Tests: Use particular caution when testing devices containing solid-state components. Perform the following according to manufacturer's written instructions:

1. Continuity tests of circuits.

2. Operational Tests: Set and operate controls to demonstrate their functions and capabilities in a methodical sequence that cues and reproduces actual operating functions.

a. Include testing of timing control equipment under conditions that simulate actual operational conditions. Record control settings, operations, cues, and functional observations.

F. Correct deficiencies, make adjustments, and retest. Verify that specified requirements are met.

G. Test labeling: After satisfactory completion of tests and inspection, apply a label to tested components indicating test results, date, and responsible agency and representative.

H. Reports: Written reports of tests and observations. Record defective materials and workmanship and unsatisfactory test results. Record repairs and adjustments.

3.4 CLEANING

A. Cleaning: Clean equipment and devices internally and externally using methods and materials recommended by the manufacturers, and repair damaged finishes.

3.5 DEMONSTATION

A. Coordinate training for low-voltage, programmable lighting systems.

B. Engage a factory-authorized service representative to train Owner's maintenance personnel as specified below.

1. Train Owner's maintenance personnel on troubleshooting, servicing, adjusting, and maintaining equipment and schedules. Provide a minimum of two four-hour sessions on separate days for training. Use both classroom training and hands-on exercises.

2. Training Aid: User the approved final version of the maintenance manual as a training aid.

3. Schedule training with the Owner, through Architect, with at least seven days advance notice.

3.6 SYSTEM STARTUP

A. Provide manufacturer's field representative to perform systems startup.

B. Prepare and start equipment and systems in accordance with manufacturers' instructions and recommendations.

C. Record basic parameter setup and set points required to operate the drive correctly.

END OF SECTION 26 29 13

SECTION 26 2913

ENCLOSED CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes the following enclosed controllers rated 600 V and less:

1. Full-voltage manual.
2. Full-voltage magnetic.
3. Reduced-voltage solid state.
4. Multispeed.

B. Related Section:

1. Division 26 Section "Variable-Frequency Motor Controllers" for general-purpose, ac, adjustable-frequency, pulse-width-modulated controllers for use on variable torque loads in ranges up to 200 hp.

1.3 DEFINITIONS

A. CPT: Control power transformer.

B. MCCB: Molded-case circuit breaker.

C. MCP: Motor circuit protector.

D. N.C.: Normally closed.

E. N.O.: Normally open.

F. OCPD: Overcurrent protective device.

G. SCR: Silicon-controlled rectifier.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Enclosed controllers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.5 SUBMITTALS

A. Product Data: For each type of enclosed controller. Include manufacturer's technical data on features, performance, electrical characteristics, ratings, and enclosure types and finishes.

B. Shop Drawings: For each enclosed controller. Include dimensioned plans, elevations, sections, details, and required clearances and service spaces around controller enclosures.

1. Show tabulations of the following:

a. Each installed unit's type and details.

b. Factory-installed devices.

c. Nameplate legends.

d. Short-circuit current rating of integrated unit.

e. Listed and labeled for integrated short-circuit current (withstand) rating of OCPDs in combination controllers by an NRTL acceptable to authorities having jurisdiction.

f. Features, characteristics, ratings, and factory settings of individual OCPDs in combination controllers.

2. Wiring Diagrams: For power, signal, and control wiring.

C. Seismic Qualification Certificates: For enclosed controllers, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Field quality-control reports.

E. Operation and Maintenance Data: For enclosed controllers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Routine maintenance requirements for enclosed controllers and installed components.

2. Manufacturer's written instructions for testing and adjusting circuit breaker and MCP trip settings.

3. Manufacturer's written instructions for setting field-adjustable overload relays.

4. Manufacturer's written instructions for testing, adjusting, and reprogramming reduced-voltage solid-state controllers.

F. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor running overload protection suit actual motors to be protected.

1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

C. IEEE Compliance: Fabricate and test enclosed controllers according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store enclosed controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.

B. If stored in areas subject to weather, cover enclosed controllers to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install temporary electric heating, with at least 250 W per controller.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).

2. Altitude: Not exceeding 6600 feet (2010 m).

B. Comply with NFPA 70E.

1.9 COORDINATION

A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

PART 2 - PRODUCTS

2.1 FULL-VOLTAGE CONTROLLERS

A. General Requirements for Full-Voltage Controllers: Comply with NEMA ICS 2, general purpose, Class A.

B. Motor-Starting Switches: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off or on.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.

c. Siemens Energy & Automation, Inc.

d. Square D; a brand of Schneider Electric.

2. Configuration: Nonreversing.

3. Flush or surface mounting.

4. Red pilot light.

C. Fractional Horsepower Manual Controllers: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.

c. Siemens Energy & Automation, Inc.

d. Square D; a brand of Schneider Electric.

2. Configuration: Nonreversing.

3. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters matched to nameplate full-load current of actual protected motor; external reset push button; bimetallic type.

4. Surface mounting.

5. Red pilot light.

D. Magnetic Controllers: Full voltage, across the line, electrically held.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.

c. Siemens Energy & Automation, Inc.

d. Square D; a brand of Schneider Electric.

2. Configuration: Nonreversing.

3. Contactor Coils: Pressure-encapsulated type.

a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.

4. Power Contacts: Totally enclosed, double-break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.

5. Control Circuits: 24 or 120-V ac, as required by the control circuit; obtained from integral CPT, with primary and secondary fuses, with CPT of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.

a. CPT Spare Capacity: 100 VA.

6. Solid-State Overload Relay:

a. Switch or dial selectable for motor running overload protection.

b. Sensors in each phase.

c. Class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.

d. Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.

e. Analog communication module.

7. N.C./N.O., isolated overload alarm contact.

8. External overload reset push button.

E. Combination Magnetic Controller: Factory-assembled combination of magnetic controller, OCPD, and disconnecting means.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.

c. Siemens Energy & Automation, Inc.

d. Square D; a brand of Schneider Electric.

2. Fusible Disconnecting Means:

   a. NEMA KS 1, heavy-duty, horsepower-rated, fusible switch with clips or bolt pads to accommodate indicated fuses.

   b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.

   c. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.

3. Nonfusible Disconnecting Means:

   a. NEMA KS 1, heavy-duty, horsepower-rated, nonfusible switch.

   b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.

   c. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.

4. MCP Disconnecting Means:

   a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents, instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.

   b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.

   c. Auxiliary contacts "a" and "b" arranged to activate with MCP handle.

   d. N.C./N.O. alarm contact that operates only when MCP has tripped.

   e. Current-limiting module to increase controller short-circuit current (withstand) rating to 100 kA.

5. MCCB Disconnecting Means:

   a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents; thermal-magnetic MCCB, with inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits.

   b. Front-mounted, adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

   c. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.

   d. Auxiliary contacts "a" and "b" arranged to activate with MCCB handle.

   e. N.C./N.O. alarm contact that operates only when MCCB has tripped.

2.2 MULTISPEED MAGNETIC CONTROLLERS

A. General Requirements for Multispeed Magnetic Controllers: Comply with NEMA ICS 2, general purpose, Class A.

B. Multispeed Magnetic Controllers: Two speed, full voltage, across the line, electrically held.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.

c. Siemens Energy & Automation, Inc.

d. Square D; a brand of Schneider Electric.

2. Configuration: Nonreversing; consequent pole or two winding types as required by the motor being controlled.

3. Contactor Coils: Pressure-encapsulated type.

a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.

4. Power Contacts: Totally enclosed, double break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.

5. Control Circuits: 24 or 120-V ac, as required by the control circuit; obtained from integral CPT, with primary and secondary fuses, with CPT of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.

a. CPT Spare Capacity: 100 VA.

6. Compelling relays shall ensure that motor will start only at low speed.

7. Accelerating timer relays shall ensure properly timed acceleration through speeds lower than that selected.

8. Decelerating timer relays shall ensure automatically timed deceleration through each speed.

9. Antiplugging timer relays shall ensure a time delay when transferring from FORWARD to REVERSE and back.

10. Solid-State Overload Relay:

a. Switch or dial selectable for motor running overload protection.

b. Sensors in each phase.

c. Class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.

d. Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.

11. N.C./N.O., isolated overload alarm contact.

12. External overload reset push button.

2.3 ENCLOSURES

A. Enclosed Controllers: NEMA ICS 6, to comply with environmental conditions at installed location.

1. Dry and Clean Indoor Locations: Type 1.

2. Outdoor Locations: Type 3R.

3. Kitchen and Wash-Down Areas: Type 4X, stainless steel.

4. Other Wet or Damp Indoor Locations: Type 4.

5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12.

2.4 ACCESSORIES

A. General Requirements for Control Circuit and Pilot Devices: NEMA ICS 5; factory installed in controller enclosure cover unless otherwise indicated.

1. Push Buttons, Pilot Lights, and Selector Switches: Heavy-duty, oiltight type.

a. Push Buttons: Covered, lockable types; maintained or momentary as indicated.

b. Pilot Lights: LED types; colors as indicated; push to test.

c. Selector Switches: Rotary type.

B. N.C./N.O. auxiliary contact(s).

C. Control Relays: Auxiliary and adjustable solid-state time-delay relays.

D. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.

E. Cover gaskets for Type 1 enclosures.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and surfaces to receive enclosed controllers, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

B. Examine enclosed controllers before installation. Reject enclosed controllers that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Wall-Mounted Controllers: Install enclosed controllers on walls with tops at uniform height unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."

B. Floor-Mounted Controllers: Install enclosed controllers on 4-inch (100-mm) nominal-thickness concrete base. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete."

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.

2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.

3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

4. Install anchor bolts to elevations required for proper attachment to supported equipment.

C. Seismic Bracing: Comply with requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

E. Install fuses in each fusible-switch enclosed controller.

F. Install fuses in control circuits if not factory installed. Comply with requirements in Division 26 Section "Fuses."

G. Install heaters in thermal overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.

H. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.

I. Comply with NECA 1.

3.3 IDENTIFICATION

A. Identify enclosed controllers, components, and control wiring. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.

2. Label each enclosure with engraved nameplate.

3. Label each enclosure-mounted control and pilot device.

3.4 CONTROL WIRING INSTALLATION

A. Install wiring between enclosed controllers and remote devices and facility's central control system. Comply with requirements in Division 26 Section "Control-Voltage Electrical Power Cables."

B. Bundle, train, and support wiring in enclosures.

C. Connect selector switches and other automatic-control selection devices where applicable.

1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switch is in manual-control position.

2. Connect selector switches with enclosed-controller circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed controller, component, connecting supply, feeder, and control circuit.

2. Test continuity of each circuit.

C. Tests and Inspections:

1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.

2. Test insulation resistance for each enclosed-controller element, component, connecting motor supply, feeder, and control circuits.

3. Test continuity of each circuit.

4. Verify that voltages at controller locations are within plus or minus 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Architect and Owner before starting the motor(s).

5. Test each motor for proper phase rotation.

6. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

8. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. Enclosed controllers will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports including a certified report that identifies enclosed controllers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

A. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

B. Adjust overload-relay heaters or settings if power factor correction capacitors are connected to the load side of the overload relays.

C. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable instantaneous trip elements. Initially adjust to six times the motor nameplate full-load ampere ratings and attempt to start motors several times, allowing for motor cooldown between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Architect and Owner before increasing settings.

D. Set field-adjustable switches and program microprocessors for required start and stop sequences in reduced-voltage solid-state controllers.

E. Set field-adjustable circuit-breaker trip ranges.

3.7 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until enclosed controllers are ready to be energized and placed into service.

B. Replace controllers whose interiors have been exposed to water or other liquids prior to Substantial Completion.

END OF SECTION 26 29 13

SECTION 26 2923

VARIABLE-FREQUENCY MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Work includes the complete installation, electrical connections, testing, and commissioning of the Variable Frequency Drive systems (VFDs.)

C. The contractor shall provide specified VFD harmonic mitigation and system testing as part of these VFD requirements.

D. VFD harmonic mitigation equipment shall be included as part of the VFD package.

1.2 SUMMARY

A. Section includes separately enclosed, pre-assembled, combination VFCs, rated 600 V and less, for speed control of three-phase, squirrel-cage induction motors.

B. Related Sections:

1. Division 26 Section "Motor-Control Centers" for VFCs installed in motor-control centers.

1.3 DEFINITIONS

A. BAS: Building automation system.

B. CE: Conformite Europeene (European Compliance).

C. CPT: Control power transformer.

D. EMI: Electromagnetic interference.

E. IGBT: Insulated-gate bipolar transistor.

F. LAN: Local area network.

G. LED: Light-emitting diode.

H. MCP: Motor-circuit protector.

I. NC: Normally closed.

J. NO: Normally open.

K. OCPD: Overcurrent protective device.

L. PCC: Point of common coupling.

M. PID: Control action, proportional plus integral plus derivative.

N. PWM: Pulse-width modulated.

O. RFI: Radio-frequency interference.

P. TDD: Total demand (harmonic current) distortion.

Q. THD(V): Total harmonic voltage demand.

R. VFC: Variable-frequency motor controller.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic Performance: VFCs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.5 SUBMITTALS

A. Product Data: For each type and rating of VFC indicated. Include features, performance, electrical ratings, operating characteristics, shipping and operating weights, and furnished specialties and accessories.

B. Custom Shop Drawings: (standard factory sales brochure/data is not acceptable) For each VFC indicated. Include dimensioned plans, elevations, and sections; and conduit entry locations and sizes, mounting arrangements, and details, including required clearances and service space around equipment.

1. Show tabulations of installed devices, equipment features, and ratings. Include the following:

a. Each installed unit's type and details.

b. Factory-installed devices.

c. Enclosure types and details.

d. Nameplate legends.

e. Short-circuit current (withstand) rating of enclosed unit.

f. Features, characteristics, ratings, and factory settings of each VFC and installed devices.

g. Specified modifications.

2. Schematic and Connection Wiring Diagrams: For power, signal, and control wiring.

C. Harmonic Test Prototype Report: Submit prototype test report for each VFC and filter method combination for this project. Show total harmonic distortion levels in voltage and current for a range of frequencies: 25%, 50%, 75% and 100% of 60 Hz.

D. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout, required working clearances, and required area above and around VFCs. Show VFC layout and relationships between electrical components and adjacent structural and

mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.

E. Qualification Data: For qualified testing agency.

F. Seismic Qualification Certificates: For VFCs, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based, and their installation requirements.

G. Product Certificates: For each VFC, from manufacturer.

H. Source quality-control reports.

I. Field quality-control reports.

J. Operation and Maintenance Data: For VFCs to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting thermal-magnetic circuit breaker and MCP trip settings.

2. Manufacturer's written instructions for setting field-adjustable overload relays.

3. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.

4. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.

5. Schematic drawings.

6. Catalog sheets.

7. Diagrams/pictures showing actual components and parts numbers.

8. Test Certificates.

9. Warranty information.

10. Listing of service personnel responsible for warranty repairs.

K. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed and arrange to demonstrate that switch settings for motor-running overload protection suit actual motors to be protected.

1.6 QUALITY ASSURANCE

A. Provide UL 508 listing on assembled drive.

B. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with NFPA 70.

E. Listed and carry the label of at least one of the following:

1. UL.

2. ETL.

F. IEEE Compliance: Fabricate and test VFC according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

1.7 DELIVERY, STORAGE, AND HANDLING

A. If stored in space that is not permanently enclosed and air conditioned, remove loose packing and flammable materials from inside controllers and install temporary electric heating, with at least 250 W per controller.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation, capable of driving full load without derating, under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than 14 deg F (minus 10 deg C) and not exceeding 104 deg F (40 deg C).

2. Ambient Storage Temperature: Not less than minus 4 deg F (minus 20 deg C) and not exceeding 140 deg F (60 deg C)

3. Humidity: Less than 95 percent (noncondensing).

4. Altitude: Not exceeding 6000 feet (1800 m).

B. Comply with NFPA 70E

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for VFCs, including clearances between VFCs, and adjacent surfaces and other items.

1.9 COORDINATION

A. Coordinate features of motors, load characteristics, installed units, and accessory devices to be compatible with the following:

1. Torque, speed, and horsepower requirements of the load.

2. Ratings and characteristics of supply circuit and required control sequence.

3. Ambient and environmental conditions of installation location.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases.

C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace VFCs that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 3 years minimum from date of vendor start-up.

2. Warranty shall include the entire VFD system including harmonics.

1.11 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

2. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.

3. Indicating Lights: Two of each type and color installed.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following approved suppliers (manufacturers):

1. Energy Management Corporation (Mitsubishi) Motor Drives International

2. Long Building Environments/Bisel (Yaskawa)

3. Midgley-Huber (ABB)

4. Dan Foss

B. General Requirements for VFCs: Comply with NEMA ICS 7, NEMA ICS 61800-2, and UL 508C.

C. Application: Constant torque and variable torque.

D. VFC Description: Variable-frequency power converter (rectifier, dc bus, and IGBT, PWM inverter) factory packaged in an enclosure, with integral disconnecting means, overcurrent and overload protection, and harmonic filter; listed and labeled by an NRTL as a complete unit; arranged to provide self-protection, protection, and variable-speed control of one or more three-phase induction motors by adjusting output voltage and frequency.

1. Units suitable for operation of NEMA MG 1, Design A and Design B motors as defined by NEMA MG 1, Section IV, Part 30, "Application Considerations for Constant Speed Motors Used on a Sinusoidal Bus with Harmonic Content and General Purpose Motors Used with Adjustable-Voltage or Adjustable-Frequency Controls or Both."

2. Units suitable for operation of inverter-duty motors as defined by NEMA MG 1, Section IV, Part 31, "Definite-Purpose Inverter-Fed Polyphase Motors."

3. Listed and labeled for integrated short-circuit current (withstand) rating by an NRTL acceptable to authorities having jurisdiction.

E. Do not provide manual bypass within VFC.

F. Design and Rating: Match load type, such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.

G. Output Rating: Three-phase; 10 to 60 Hz, with voltage proportional to frequency throughout voltage range; maximum voltage equals input voltage.

H. Unit Operating Requirements:

1. Input AC Voltage Tolerance: Plus 10 and minus 15 percent of VFC input voltage rating.

2. Input AC Voltage Unbalance: Not exceeding 3 percent.

3. Input Frequency Tolerance: Plus or minus 3 percent of VFC frequency rating.

4. Minimum Efficiency: 97 percent at 60 Hz, full load.

5. Minimum Displacement Primary-Side Power Factor: 98 percent under any load or speed condition.

6. Minimum Short-Circuit Current (Withstand) Rating: Equal to or greater than the AIC rating of gear feeding the drive. Where AIC rating is unknown a minimum of 65 kA shall be provided.

7. Ambient Temperature Rating: Not less than 14 deg F (minus 10 deg C) and not exceeding 104 deg F (40 deg C).

8. Ambient Storage Temperature Rating: Not less than minus 4 deg F (minus 20 deg C) and not exceeding 140 deg F (60 deg C)

9. Humidity Rating: Less than 95 percent (noncondensing).

10. Altitude Rating: Not exceeding 6000 feet (1800 m). Ensure drive is derated for elevation above 3300 feet and rated at full capacity up to 5000 feet elevation.

11. Vibration Withstand: Comply with IEC 60068-2-6.

12. Overload Capability for high overload capacity (constant torque) drives: 1.1 times the base load current indefinitely; 1.5 times the base load current for 60 seconds; minimum of 1.8 times the base load current for three seconds.

13. Overload Capability for normal overload capacity (variable torque) drives: 1.1 times the base load current indefinitely; 1.2 times the base load current for 60 seconds; minimum of 1.8 times the base load current for three seconds.

14. Starting Torque: Minimum 100 percent of rated torque from 3 to 60 Hz.

15. Speed Regulation: Plus or minus 5 percent.

16. Output Carrier Frequency: Selectable; 0.5 to 15 kHz.

17. Stop Modes: Programmable; includes fast, free-wheel, and dc injection braking.

I. Inverter Logic: Microprocessor based, 32 bit, isolated from all power circuits.

J. Isolated Control Interface: Allows VFCs to follow remote-control signal over a minimum 40:1 speed range.

1. Signal: Electrical.

2. Signal: Pneumatic.

K. Internal Adjustability Capabilities:

1. Minimum Speed: 5 to 25 percent of maximum rpm.

2. Maximum Speed: 80 to 100 percent of maximum rpm.

3. Acceleration: 0.1 to 999.9 seconds.

4. Deceleration: 0.1 to 999.9 seconds.

5. Current Limit: 30 to minimum of 150 percent of maximum rating.

L. Self-Protection and Reliability Features:

1. Input transient protection by means of surge suppressors to provide three-phase protection against damage from supply voltage surges 10 percent or more above nominal line voltage.

2. Loss of Input Signal Protection: Selectable response strategy, including speed default to a percent of the most recent speed, a preset speed, or stop; with alarm.

3. Under- and overvoltage trips.

4. Inverter overcurrent trips.

5. VFC and Motor Overload/Overtemperature Protection: Microprocessor-based thermal protection system for monitoring VFCs and motor thermal characteristics, and for providing VFC overtemperature and motor overload alarm and trip; settings selectable via the keypad; NRTL approved.

6. Critical frequency rejection, with three selectable, adjustable deadbands.

7. Instantaneous line-to-line and line-to-ground overcurrent trips.

8. Loss-of-phase protection.

9. Reverse-phase protection.

10. Short-circuit protection.

11. Motor overtemperature fault.

M. Automatic Reset/Restart: Attempt three restarts after drive fault or on return of power after an interruption and before shutting down for manual reset or fault correction; adjustable delay time between restart attempts.

N. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped, unless "Bidirectional Autospeed Search" feature is available and engaged.

O. Bidirectional Autospeed Search: Capable of starting VFC into rotating loads spinning in either direction and returning motor to set speed in proper direction, without causing damage to drive, motor, or load.

P. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.

Q. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.

R. Integral Input Disconnecting Means and OCPD: Motor circuit protector type circuit breaker that is externally operable from the outside of the VFD panel.

1. Auxiliary Contacts: NO/NC, arranged to activate before switch blades open.

2. Auxiliary contacts "a" and "b" arranged to activate with circuit-breaker handle.

3. NC/NO alarm contact that operates only when circuit breaker has tripped.

S. VFD shall include Interlock capabilities with local disconnect switch at motor when VFD is remote (not within sight) of motor(s) being controlled.

T. Permanently label all internal wiring.

U. Control voltage shall be 120V.

V. Provide fire alarm fan/VFD shutdown input.

W. Doors must not require special tools to open.

X. Provide a terminal block for VFD feeders to connect to, provide factory wiring between terminal block and VFD output terminals.

2.2 CONTROLS AND INDICATION

A. Status Lights: Door-mounted LED indicators or other acceptable status indication displaying the following conditions:

1. Power on.

2. Run.

3. Overvoltage.

4. Line fault.

5. Overcurrent.

6. External fault.

7. VFD Fault light

B. Panel-Mounted Operator Station: Manufacturer's standard front-accessible, sealed keypad and plain-English language digital display; allows complete programming, program copying, operating, monitoring, and diagnostic capability.

1. Keypad: In addition to required programming and control keys, include keys for HAND, OFF, and AUTO modes.

2. Security Access: Provide electronic security access to controls through identification and password with at least three levels of access: View only; view and operate; and view, operate, and service.

a. Control Authority: Supports at least four conditions: Off, local manual control at VFC, local automatic control at VFC, and automatic control through a remote source.

C. Historical Logging Information and Displays:

1. Not required, BAS shall be used to track and time stamp.

D. Indicating Devices: Digital displayand additional readout devices as required, mounted flush in VFC door and connected to display VFC parameters including, but not limited to:

1. Output frequency (Hz).

2. Motor speed (rpm).

3. Motor status (running, stop, fault).

4. Motor current (amperes).

5. Motor torque (percent).

6. Fault or alarming status (code).

7. PID feedback signal (percent).

8. DC-link voltage (V dc).

9. Set point frequency (Hz).

10. Motor output voltage (V ac).

E. Control Signal Interfaces:

1. Electric Input Signal Interface:

a. A minimum of two programmable analog inputs: 0- to 10-V dc; 4- to 20-mA dc.

b. A minimum of six multifunction programmable digital inputs.

2. Pneumatic Input Signal Interface: 3 to 15 psig (20 to 104 kPa).

3. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the BAS or other control systems:

   a. 0- to 10-V dc.

   b. 4- to 20-mA dc.

   c. Potentiometer using up/down digital inputs.

   d. Fixed frequencies using digital inputs.

4. Output Signal Interface: A minimum of two programmable analog output signal(s) (0- to 10-V dc and 4- to 20-mA dc), which can be configured for any of the following:

   a. Output frequency (Hz).

   b. Output current (load).

   c. DC-link voltage (V dc).

   d. Motor torque (percent).

   e. Motor speed (rpm).

   f. Set point frequency (Hz).

5. Remote Indication Interface: A minimum of two programmable dry-circuit relay outputs (120-V ac, 1 A) for remote indication of the following:

   a. Motor running.

   b. Set point speed reached.

   c. Fault and warning indication (overtemperature or overcurrent).

   d. PID high- or low-speed limits reached.

6. Remote Switch

7. Termination points on a terminal strip for field connections:

   a. Safeties Interlock (N.C. contacts located remote)

   b. Remote Start/Stop Contact (N.O. contacts located remote).

   c. Remote VFC Fault Contacts (N.C.).

   d. Remote VFC Enable Contacts (N.O.).

   e. Remote Electronic Signal Input.

F. PID Control Interface: Provides closed-loop set point, differential feedback control in response to dual feedback signals. Allows for closed-loop control of fans and pumps for pressure, flow, or temperature regulation.

1. Number of Loops: Two.

G. BAS Interface: Factory-installed hardware and software to enable the BAS to monitor, control, and display VFC status and alarms and energy usage. Allows VFC to be used with an external system within a multidrop LAN configuration; settings retained within VFC's nonvolatile memory.

1. Network Communications Ports: Ethernet and RS-422/485.

2. Embedded BAS Protocols for Network Communications: Provide capability for all of the following, and coordinate exact type with the BAS installer; protocols accessible via the communications ports:

a. ASHRAE 135 BACnet

b. Modbus/Memobus

2.3 LINE CONDITIONING AND FILTERING

A. Input Line Conditioning: Factory installed integral to the VFC enclosure as one UL listed assembly:

1. Motors Less than 15 HP: AC line reactors with a minimum of 3% impedance and DC choke.

2. Motors 15 HP and Larger shall have harmonic correction of 12% THID current or less and 3% voltage distortion or less at the input of the VFD terminals. This shall be accomplished by using Harmonic filters or a minimum of 12 pulse drive that will comply with the power quality performance requirements. A harmonic test will be performed by an independent third party. If the manufacturer fails to meet the harmonic limits, they will replace the VFD system at their expense with another VFD system meeting these requirements.

B. Output Filtering: Integral output filter where VFC is located greater than 50’ (15 m) from the motor it is controlling.

C. Filter/Transformers shall be factory wired.

2.4 OPTIONAL FEATURES

A. Multiple-Motor Capability: VFC suitable for variable-speed service to multiple motors. Overload protection shuts down VFC and motors served by it, and generates fault indications, when overload protection activates.

1. Configure to allow two or more motors to operate simultaneously at the same speed; separate overload relay for each controlled motor.

2.5 ENCLOSURES

A. VFC Enclosures: NEMA 250, to comply with environmental conditions at installed location.

1. Dry and Clean Indoor Locations: Type 1 filtered and force ventilated.

2. Outdoor Locations: Type 3R filtered and force ventilated.

3. Kitchen and wash-Down Areas: Type 4X.

4. Other Wet or Damp Indoor Locations: Type 3R filtered and force ventilated.

B. Plenum Rating: UL 1995; NRTL certification label on enclosure, clearly identifying VFC as "Plenum Rated."

2.6 ACCESSORIES

A. General Requirements for Control-Circuit and Pilot Devices: NEMA ICS 5; factory installed in VFC enclosure cover unless otherwise indicated.

1. Push Buttons, Pilot Lights, and Selector Switches: Heavy-duty, oiltight type.

a. Push Buttons: Covered; maintained or momentary.

b. Pilot Lights: LED types; push to test.

c. Selector Switches: Rotary type.

B. Control Relays: Auxiliary and adjustable solid-state time-delay relays.

C. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.

1. Current Transformers: Continuous current rating, basic impulse insulating level (BIL) rating, burden, and accuracy class suitable for connected circuitry. Comply with IEEE C57.13.

D. Cooling Fan and Exhaust System: NEMA 1 enclosure for VFD’s beyond 25 HP supply fan, with composite intake and exhaust grills and filters; 120 -V ac; obtained from integral CPT.

E. Ventilated, NEMA 1 enclosure with filter for VFD’s 25 HP and less.

F. Sun shields installed on fronts, sides, and tops of enclosures installed outdoors and subject to direct and extended sun exposure.

G. Spare control-wiring terminal blocks ; wired.

2.7 SOURCE QUALITY CONTROL

A. Testing: Test and inspect VFCs according to requirements in NEMA ICS 61800-2.

1. Test each VFC while connected to a motor that is comparable to that for which the VFC is rated.

2. Verification of Performance: Rate VFCs according to operation of functions and features specified.

B. VFCs will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, surfaces, and substrates to receive VFCs, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance.

B. Examine VFC before installation. Reject VFCs that are wet, moisture damaged, or mold damaged.

C. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFC installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Coordinate layout and installation of VFCs with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Wall-Mounting Controllers: Install VFCs on walls with tops at uniform height and with disconnect operating handles not higher than 79 inches (2000 mm) above finished floor unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not on walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."

C. Floor-Mounting Controllers: Install VFCs on 4-inch (100-mm) nominal thickness concrete base. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete."

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.

2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.

3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

4. Install anchor bolts to elevations required for proper attachment to supported equipment.

D. Roof-Mounting Controllers: Install VFC on roofs with tops at uniform height and with disconnect operating handles not higher than 79 inches (2000 mm) above finished roof surface unless otherwise indicated, and by bolting units to curbs or mounting on freestanding, lightweight, structural-steel channels bolted to curbs. Seal roof penetrations after raceways are installed.

1. Curbs and roof penetrations are specified in Division 07 Section "Roof Accessories."

2. Structural-steel channels are specified in Division 26 Section "Hangers and Supports for Electrical Systems."

E. Seismic Bracing: Comply with requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

F. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

G. Install fuses in each fusible-switch VFC.

H. Install fuses in control circuits if not factory installed. Comply with requirements in Division 26 Section "Fuses."

I. Install heaters in thermal-overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.

J. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.

K. The variable frequency drive inverter unit shall be mounted on a removable panel to facilitate maintenance.

L. New filters shall be installed into VFD units just prior to substantial completion, when system maintenance will become the owner’s responsibility.

M. Comply with NECA 1.

3.3 IDENTIFICATION

A. Identify VFCs, components, and control wiring. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, [control signal used,]and components; provide warning signs.

2. Label each VFC with engraved nameplate.

3. Label each enclosure-mounted control and pilot device.

B. Operating Instructions: Frame printed operating instructions for VFCs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of VFC units.

3.4 CONTROL WIRING INSTALLATION

A. Install wiring between VFCs and remote devices and facility's central-control system. Comply with requirements in Division 26 Section "Control-Voltage Electrical Power Cables."

B. Provide all conduit and wiring to interlock VFD with remote disconnect switches.

C. Bundle, train, and support wiring in enclosures.

D. Connect selector switches with control circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified third party testing agency to perform tests and inspections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Acceptance Testing Preparation:

1. Test insulation resistance for each VFC element, bus, component, connecting supply, feeder, and control circuit.

2. Test continuity of each circuit.

D. Tests and Inspections:

1. Inspect VFC, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.

2. Test insulation resistance for each VFC element, component, connecting motor supply, feeder, and control circuits.

3. Test continuity of each circuit.

4. Verify that voltages at VFC locations are within 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Architect and Owner before starting the motor(s).

5. Measure total harmonic distortion levels for voltage and current at the input terminals to the VFC. Record values for a range of frequencies: 25%, 50%, 75% and 100%.

6. Test each motor for proper phase rotation.

7. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

8. Include all measurements in the harmonic distortion report. Provide report to Engineer for review.

9. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

10. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

E. VFCs will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports, including a certified report that identifies the VFC and describes test results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.6 STARTUP SERVICE

A. Contractor will measure and verify power quality of VFD. Deviations from minimum power quality performance specified will be remedied by the Contractor at no additional cost the Owner until power quality measurements comply with specifications.

B. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

C. Replace Filters with new at substantial completion.

3.7 ADJUSTING

A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.

B. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

C. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements. Initially adjust to six times the motor nameplate full-load amperes and attempt to start motors several times, allowing for motor cool-down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Architect and Owner before increasing settings.

D. Set field-adjustable circuit-breaker trip ranges.

E. Set field-adjustable pressure switches.

3.8 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until controllers are ready to be energized and placed into service.

B. Replace VFCs whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, reprogram, and maintain VFCs.

END OF SECTION 26 29 23

SECTION 26 3323

CENTRAL BATTERY EQUIPMENT FOR EMERGENCY LIGHTING

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. All sections of Division 01, General Requirements, apply to this section.

B. Coordinate with Commissioning Work. Comply with the requirements of Division 01 Section “General Commissioning Requirements” and Division 26 Section “Electrical Commissioning.”

1.2 SUMMARY

A. Section includes the following central battery and power conversion equipment rated 600 V and less for emergency lighting:

1. Interruptible (fast-transfer) central battery equipment.

1.3 DEFINITIONS

A. BMS: Building Management System.

B. IBC: International Building Code.

C. Interruptible: As used in the Section Text, an off-line, passive-standby or line-interactive, inverter-only unit, with an intentional interruption of power to the load until an internal transfer switch picks up and transfers the load to the unit's inverter and internal battery source on loss of the "normal" source, and then retransfers to the "normal" source when it is restored. Transfer time can be "slow" (up to approximately 1 second) or "fast" (2-4 ms or 40-50 ms, depending on manufacturer).

D. LED: Light-emitting diode.

E. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

F. NiCad: Nickel cadmium.

G. OCPD: Overcurrent protective device.

H. PC: Personal computer.

I. PWM: Pulse-width modulated.

J. TDD: Total demand (harmonic current) distortion (also listed as "THD" in catalog data by manufacturers).

K. THD (V): Total harmonic voltage demand.

L. Uninterruptible: As used in the Section Text, an on-line, double-conversion (rectifier/inverter) unit, with no interruption of power to the load on interruption and restoration of the "normal" source.

M. UPS: Uninterruptible power supply.

N. VRLA: Valve-regulated lead acid.

1.4 SUBMITTALS

A. Provide point-by-point statement of compliance with specifications, in accordance with Section 260500.1.5B.

B. Product Data: For each type and rating of central battery equipment unit.

1. Include features, performance, electrical ratings, operating characteristics, shipping and operating weights, shipping splits, and furnished options, specialties, and accessories.

C. Shop Drawings: For each type and rating of central battery equipment unit.

1. Include shop drawings of electrical rooms that show spatial relationships and clearances to all electrical gear and equipment.

2. Include plans, elevations, sections, and mounting details.

3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, ventilation requirements, method of field assembly, components, and location and size of each field connection.

4. Include system one-line diagram, internal and interconnecting wiring; and diagrams for power, signal, and control wiring.

5. Include elevation, details, and legends of control and indication displays.

6. Include -circuit current (withstand) rating of unit.

D. Short circuit and coordination study and arc flash hazard reports prior to release for construction. Equipment is subject to change based on the results of the short circuit, coordination, and arc-flash hazard studies. Equipment submittals will not be approved until the short circuit, coordination, and arc-flash hazard studies have been approved.

E. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout, required working clearances, and required area above and around central battery equipment. Show central battery equipment layout and relationships between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.

F. Seismic Qualification Certificates: For central battery equipment, accessories, and components, from manufacturer.

1. Certificate of compliance.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

G. Product Certificates: For each type of central battery equipment.

H. Harmonic Analysis Study and Report: Provide factory prototype test report of input and output voltage and current THD levels to show that unit operates within specified limits..

I. Source quality-control reports.

J. Field quality-control reports.

K. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For central battery equipment to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. Manufacturer's written instructions for testing central battery equipment.

b. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.

c. Manufacturer's written instructions for selecting and setting field-adjustable controls and status and alarm points

1.6 SUBSTITUTIONS

A. Submit request for substitution of materials as part of product submittal, in accordance with the requirements of Division 01.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Manufacturer: Company specializing in manufacturing products specified in this section with minimum 10 years' experience.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment in fully enclosed vehicles.

B. Store equipment in spaces having environments controlled within manufacturers' written instructions for ambient temperature and humidity conditions for non-operating equipment.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Less than 0 deg F or exceeding 104 deg F, with an average value exceeding 95 deg F over a 24-hour period.

2. Ambient Storage Temperature: Not less than minus 4 deg F and not exceeding 140 deg F.

3. Humidity: More than 95 percent (condensing).

4. Altitude: 4200 feet above sea level.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for central battery equipment, including clearances between central battery equipment and adjacent surfaces and other items.

1.10 COORDINATION

A. Coordinate sizes and locations of concrete bases. Cast anchor-bolt inserts into bases.

1.11 WARRANTY

A. Comply with the requirements outlined in Section 26 05 00, “Common Work Results for Electrical.”

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Central battery equipment shall withstand the effects of earthquake motions determined according to ASCE/SEI 7. The designated central battery equipment shall be tested and certified by an NRTL as meeting ICC-ES AC 156 test procedure requirements.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2.2 INTERRUPTIBLE (FAST-TRANSFER) CENTRAL BATTERY EQUIPMENT

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Hubbell Dual-Lite:
    a. Trident TRF Series, Three-Phase.
    b. D Series, Single-Phase.
2. Sure-Lights:
    a. Lifeway II Series, Three-Phase
    b. Lifeway II Series, Single-Phase

3. Myers Power Products:

    a. Illuminator CIII Series, Three-Phase.

    b. Illuminator IE Series, Single-Phase.

4. Perfect Power Systems

    a. PowerRide 4-Hybrid Series, Three-Phase

    b. PowerRide 1 Series, Single-Phase

B. General Requirements for Interruptible (Fast-Transfer) Central Battery Equipment:

1. NRTL Compliance: Fabricate and label central battery equipment to comply with UL 924a.

2. Comply with the IBC, NFPA 70, and NFPA 101.

3. Comply with NEMA PE 1.

4. Refer to Drawings for single-phase or three-phase unit requirements.

C. Performance Requirements:

1. Fast-Transfer Central Battery Equipment: Passive standby (off-line) system. Automatically sense loss of normal ac supply and use a solid-state static switch to transfer load. Transfer in 40-50 ms or less from normal supply to battery-inverter supply.

2. Automatic Operation:

    a. Normal Conditions: Supply the load with ac power flowing from normal ac power input terminals, bypassing inverter, with battery connected in parallel via rectifier/charger output.

    b. Abnormal Supply Conditions: If normal ac supply deviates from specified voltage, transfer switch operates and battery supplies constant, regulated ac power through the inverter to the load, with a momentary loss of power to the load.

    c. If normal power fails, solid state static transfer switch conducts and batteries supply DC power to inverter and inverter supplies regulated AC power to the load with a momentary loss of power to the load.

    d. If a fault occurs in system when being supplied by inverter and current flows in excess of the overload rating of inverter, inverter automatically protects itself against damage from overloads and short circuits by shutting down.

    e. When normal ac power is restored at input supply terminals of unit, the solid-state static transfer switch stops conducting and the controls automatically retransfer the load back to the normal ac supply, with a momentary loss of power to the load. Rectifier/charger then recharges battery.

f. If normal power failure is prolonged (more than 90 minutes), integral low-voltage battery protective circuit disconnects battery and prevents battery from damage due to deep discharge.

g. If battery becomes discharged, and when normal ac supply is again available, rectifier/charger recharges battery. When battery is fully charged, rectifier/charger automatically shifts to float-charge mode.

h. If battery is disconnected, and normal ac power is available, central battery equipment continues to supply normal power to the load with no degradation of its regulation of voltage and frequency of output bus.

D. Unit Operating Requirements:

1. Capable of taking the full starting load of lighting during transfer to battery supply and re-transfer to normal supply.

2. Input AC Voltage Tolerance: Plus 10 and minus 15 percent of central battery equipment input voltage rating.

3. Input Frequency Tolerance: Plus or minus 3 percent of central battery equipment frequency rating.

4. Synchronizing Slew Rate: 1 Hz per second, maximum.

5. Minimum Off-Line Efficiency: 99 percent at 60 Hz, full load.

6. Minimum Displacement Primary-Side Power Factor: 98 percent under any load or operating condition.

7. Ambient Temperature Rating (Other Than Batteries): Not less than 32 deg F (0 deg C) and not exceeding 104 deg F (40 deg C).

8. Ambient Storage Temperature Rating (Other Than Batteries): Not less than minus 4 deg F (minus 20 deg C) and not exceeding 158 deg F (70 deg C.)

9. Ambient Temperature Rating (Batteries): Not less than 68 deg F (20 deg C) and not exceeding 86 deg F (30 deg C).

10. Ambient Storage Temperature Rating (Batteries): Not less than 0 deg F (minus 18 deg C) and not exceeding 104 deg F (40 deg C.)

11. Humidity Rating: Less than 95 percent (noncondensing).

12. Altitude Rating: 4200 feet above sea level.

13. Off-Line Overload Capability: 1.1 times the base load current for 60 seconds; minimum of 1.8 times the base load current for three seconds.

E. Inverter and Controls Logic: Microprocessor based, isolated from all power circuits; provides complete self-diagnostics, periodic automatic testing and reporting; with alarms.

F. Controls and Indication:

1. Status Indication: Door-mounted, labeled LED indicators or digital screen displaying the following conditions:

    a. Normal power available.

    b. Status of system.

    c. Battery charging status.

    d. On battery power.

    e. System fault.

    f. External fault.

2. Panel-Mounted Operator Station: Manufacturer's standard front-accessible, sealed keypad and plain-English language digital display; allows complete programming, program copying, operating, monitoring, and diagnostic capability.

    a. Keypad: In addition to required programming and control keys, include the following:

        1) Keys for METER, CONTROL, PROGRAM, and CLEAR modes.

        2) Security Access: Provide electronic security access to controls through identification and password with at least two levels of access: View only; and view, operate, and service.

        3) Control Authority: Supports at least three conditions: Off, local manual control at unit and local automatic control at unit.

    b. Digital Display: Plain-English language messages on a digital display; provide the following historical logging information and displays:

        1) Real-time clock with current time and date.

        2) Tests and Events Logs: Record and store up to 25 tests and events.

            a) Dates.

            b) Times.

            c) Durations.

            d) Output voltage and currents.

        3) Alarm Logs: Record and store up to 25 alarms.

            a) Dates.

            b) Times.

            c) Alarm type.

4) Metering Functions: Display central battery equipment metering parameters including, but not limited to, the following:

a) Input and output voltage (V ac) and output current (A ac).

b) Battery voltage (V dc) and current (A dc).

c) Fault or alarming status (code).

d) Power output (VA).

e) Inverter load (W).

f) Ambient temperature (deg F).

g) System run time (cumulative days).

h) Inverter run time (cumulative minutes).

5) Alarm Functions: Digital display mounted flush in unit door and connected to display central battery equipment parameters including, but not limited to, the following:

a) High/low battery charge voltage.

b) High/low input voltage.

c) Battery nearing low-voltage condition.

d) Battery low voltage.

e) High ambient temperature.

f) Inverter fault.

g) Output fault.

h) Output overload.

3. Remote Signal Interfaces:

a. Remote Indication Interface: A minimum of one programmable (Form C) dry-circuit relay output(s) (120-V ac, 2 A) for remote indication of the following:

1) Normal status.

2) Fault or status indication.

3) On bypass.

4) Low battery.

b. Send trouble alarm to Building Management System (BMS) if any of the alarm functions in section 263323.11-2.2(F)(2)(b)(5) are triggered.

c. Communications Interface: Factory-installed hardware and software to enable a remote PC to program central battery equipment and monitor and display status and alarms.

1) Communications Ports:

a) RS-232 and RS-485

b) Provisions for communicating with BMS via Bacnet protocol. Coordinate with Div 23 for further details.

2) Network Communications Ports: Ethernet , RS-232, and RS-485.

3) Provide a CAT5 or CAT6 or USB port on front for plugging in a laptop PC for programming or testing.

4) Compliance with ASHRAE 135: Controllers shall support serial MS/TP and Ethernet IP communications, and shall be able to communicate directly via BMS RS-485 serial networks and Ethernet 10Base-T networks as a native device.

G. Self-Protection and Reliability Features:

1. Input transient protection by means of surge suppressors to provide protection against damage from supply voltage surges as defined in IEEE C62.45, Category B and C.

2. Integral, programmable, self-diagnostic and self-test circuitry; with alarms and logging.

3. Battery deep-discharge and self-discharge protection; with alarms.

4. Battery self-test circuitry; with alarms and logging.

H. Integral Input Disconnecting Means and OCPD: Thermal-magnetic circuit breaker, complying with UL 489.

1. Integrated Equipment Minimum Short-Circuit Current (Withstand) Rating:

a. 65kAIC fully rated, unless otherwise indicated by the short circuit and fault current study.

I. Inverter:

1. Description: Solid-state, high-frequency, PWM type, with the following operational features:

a. Automatically regulate output voltage to within plus or minus 5 percent, for all load ranges and for maximum 25 percent step-load changes; regulation may increase to 8 percent for 100 percent step-load changes.

b. Automatically regulate output frequency to within plus or minus 3 Hz, from no load to full load, at unity power factor, over the operating range of battery voltage.

c. Output Voltage Waveform: Sine wave with maximum 5 percent TDD throughout battery operating-voltage range, for 100 percent linear load.

d. Inverter Overload Capability: 115 percent for 10 minutes; 150 percent surge for 10 seconds.

e. Load Power Factor: 0.5 lead to 0.5 lag.

f. Brownout Protection: Produces rated power without draining batteries when input voltage is down to 75 percent of normal.

J. Rectifier/Battery Charger:

1. Description: Solid state, variable rate, temperature compensated; automatically maintains batteries in fully charged condition when normal power is available.

2. Maximum Battery Recharge Time from Fully Discharged State: 12 hours.

3. Low-voltage disconnect circuit reduces battery discharge during extended power outages, monitors battery voltage, and disconnects inverter when battery voltage drops to no less than 85.7 percent of nominal voltage.

4. Input current total harmonic distortion (THD) shall be less than 3% at 100% loading and 5% at 50% loading.

5.

K. Batteries:

1. Description: Sealed, **lithium-ion** batteries. Submit description of batteries with Submittals.

a. Capable of sustaining full-capacity output of inverter unit for not less than 90 minutes.

2. Battery Disconnect and OCPD: Manufacturer's standard.

3. Battery expected life: 20 years, 17,000 discharges

4. Battery Warranty: 10 years.

5. Acceptable Manufacturers:

a. Toshiba

b. Samsung

L. Maintenance Bypass Systems:

1. Maintenance Bypass Mode: Internal; manual operation only; bypasses central battery equipment power circuits (inverter and static transfer switch); requires local operator

selection at central battery equipment. Transfer and retransfer shall be make-before-break, without disrupting power to the load. Operating the switch shall be strictly restricted to authorized personnel with cabinet access key. The maintenance bypass shall be operated in conjunction with a S-1 synchronization switch, ensuring full synchronization and no inrush current during transfer.

2. Bypass Overload Capability: 1.15 times the base load current.

M. Integral Output Disconnecting Means and OCPD:

1. Multiple-Output OCPDs: Thermal-magnetic circuit breakers, complying with UL 489; voltage rating matching unit output voltage rating; 20 A, single pole.

a. Normally Closed: As scheduled on Drawings with trip alarm.

b. Normally Open: As scheduled on Drawings with trip alarm.

N. External Manual Maintenance Bypass Switch: An auto/manual MBS switch shall be provided external to the UPS cabinet/system to enable complete de-energization of incoming power to the UPS for maintenance and servicing purposes, without disrupting power to the critical load the UPS system serves. The switch shall be strictly restricted to authorized qualified personnel with cabinet access key. The MBS shall be operated in conjunction with an S-1 synchronization switch, ensuring full synchronization and no inrush current during transfer.

2.3 ENCLOSURES

A. Central Battery Equipment Enclosures: NEMA 250, to comply with environmental conditions at installed location.

1. Dry and Clean Indoor Locations: Type 1 steel cabinets with access to components through hinged doors with flush tumbler lock and latch.

2. Finish: Manufacturer's standard baked-enamel finish over corrosion-resistant prime treatment.

2.4 OPTIONAL AND ACCESSORY FEATURES

A. Factory-Installed Options and Accessories:

1. Multiple-Output Voltages: Supply unit branch circuits at different voltage levels if required. Transform voltages internally as required to produce indicated output voltages.

2. Split-Output Configuration: Divides output into normally on and normally off buses.

3. Auto-dialer.

4. Internal fax modem.

5. Audible alarm with silencer switch.

6. Remote Summary Alarm Panel: Labeled LEDs on panel faceplate shall indicate five basic status conditions. Audible signal indicates alarm conditions; silencing switch in face of panel silences signal without altering visual indication.

    a. Cabinet and Faceplate: Surface or flush mounted to suit mounting conditions indicated.

    b. Maximum Distance from Main Unit: 1000 feet.

7. Remote Meter Panel: Match equipment requirements of remote monitoring, controlling, and programming of central battery equipment.

    a. Cabinet and Faceplate: Surface or flush mounted to suit mounting conditions indicated.

    b. Maximum Distance from Main Unit: 150 feet.

2.5 SOURCE QUALITY CONTROL

A. Testing: Test and inspect central battery equipment according to UL 924a.

B. Factory Tests: Test and inspect assembled central battery equipment by a qualified testing agency according to UL 924a and NFPA. Affix standards organization's label. Include the following:

1. Functional test and demonstration of all functions, controls, indicators, sensors, and protective devices.

2. Full-load test.

3. Transient-load response test.

4. Overload test.

5. Power failure test.

C. Central battery equipment will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store central battery equipment according to NECA 411.

B. Examine areas, surfaces, and substrates to receive central battery equipment, with Installer present, for compliance with requirements for installation tolerances, structural support, ventilation, temperature, humidity, and other conditions affecting performance of the Work.

1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment will be installed, before installation begins.

C. Examine equipment before installation. Reject equipment that is wet, moisture damaged, or mold damaged.

D. Examine roughing-in for electrical connections to verify actual locations of connections before installation.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Coordinate layout and installation of central battery equipment with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Install central battery equipment and accessories according to NECA 411.

C. Wall-Mounted Central Battery Equipment: Install central battery equipment on walls with tops at uniform height and with disconnect operating handles no higher than 79 inches above finished floor unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For units not on walls, provide freestanding racks complying with Section 260529 "Hangers and Supports for Electrical Systems."

D. Floor-Mounted Central Battery Equipment: Install central battery equipment on concrete base. Comply with requirements for concrete base specified in Section 260529 “Hanger and Supports for Electrical Systems” and Section 033000 "Cast-in-Place Concrete."

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.

2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.

3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

4. Install anchor bolts to elevations required for proper attachment to supported equipment.

E. Seismic Bracing: Comply with requirements specified in Section 260548 "Vibration and Seismic Controls for Electrical Systems."

F. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

G. Comply with NECA 1.

H. Wiring Method: Install cables in raceways except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.

1. Provide spade type lugs for incoming/outgoing wires.

2. Tag interior wiring with slip-on type plastic sleeve, black print on white.

3. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."

3.3 CONNECTIONS

A. Connections: Interconnect system components. Make connections to supply and load circuits according to manufacturer's wiring diagrams unless otherwise indicated.

B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

1. Separately Derived Systems: Make grounding connections to grounding electrodes and bonding connections to metallic piping systems as indicated; comply with NFPA 70.

C. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 CONTROL WIRING INSTALLATION

A. Install wiring between central battery equipment and remote devices. Comply with requirements in Section 260523 "Control-Voltage Electrical Cables."

B. Bundle, train, and support wiring in enclosures.

3.5 IDENTIFICATION

A. Identify central battery equipment, components, and control wiring. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.

2. Label central battery equipment with engraved nameplates.

3. Label each separate cabinet, for multi-cabinet units.

4. Label each enclosure-mounted control and pilot device.

B. Operating Instructions: Frame printed operating instructions for central battery equipment, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of central battery equipment units.

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections:

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Acceptance Testing Preparation:

1. Inspect and Test Each Component:

a. Inspect wiring, components, connections, and equipment installations. Test and adjust components and equipment.

b. Test insulation resistance for all external branch circuit, feeder, control, and alarm wiring connected to central battery equipment element and component.

c. Test continuity of each circuit.

C. Tests and Inspections:

1. Inspect central battery equipment, wiring, components, connections, and equipment installation.

2. Test insulation resistance for all external branch circuit, feeder, control, and alarm wiring connected to central battery equipment element and component.

3. Test continuity of each circuit.

4. Verify that input voltages and frequencies at central battery equipment locations are within voltage and frequency limits specified in Part 2. If outside this range, notify Construction Manager before closing input OCPDs.

5. Perform each visual and mechanical inspection and electrical test stated in manufacturer's written instructions and in NETA Acceptance Testing Specification, including specifically those for batteries, battery chargers, and UPS, regardless of the type of central battery equipment provided. Certify compliance with test parameters.

6. Perform a load-duration test at rated voltage and rated output current to verify the correct functional operation of the unit under full-load stable operating conditions for the minimum time limits required by UL 924. Monitor and record ambient temperature and temperatures within the unit.

7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

8. Perform the following infrared (thermographic) scan tests and inspections and prepare reports:

    a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of central battery equipment. Remove front panels so joints and connections are accessible to portable scanner.

    b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of central battery equipment 11 months after date of Substantial Completion.

    c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

9. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. Central battery equipment will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies central battery equipment and describes all test results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.7 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.8 ADJUSTING

A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.

B. Set field-adjustable switches, auxiliary relays, and other adjustable parts.

C. Adjust the trip settings of thermal-magnetic circuit breakers with adjustable, instantaneous-trip elements; install fuses if not factory installed.

D. Set the automatic system test parameters.

E. Set field-adjustable, circuit-breaker trip ranges as specified in Section 260573 "Overcurrent Protective Device Coordination Study."

3.9 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until controllers are ready to be energized and placed into service.

B. Replace central battery equipment whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.10 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain central battery equipment, and to use and reprogram microprocessor-based control, monitoring, and display functions.

1. Training shall consist of a single 4-hour session.
2. Training shall be hands on and include adjustment, operation, and maintenance for the equipment.
3. Training shall include a question and answer session.
4. Training shall be video recorded. Three electronic copies of the training (in .AVI format) shall be provided within the O&M manual submittal.

B. The Contractor and/or the Systems Manufacturer's representatives shall provide a typewritten "Sequence of Operation" written for this facility.

3.11 OWNER'S QUALITY ASSURANCE

A. Owner's independent commissioning and witnessing agency will provide the following witnessing and/or review services:

1. Review factory test reports.
2. Review all test reports.
3. Witness battery testing.
4. Witness operational tests.
5. Witness BMS interface tests.

END OF SECTION 26 33 23

SECTION 26 4313

SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes field-mounted SPDs for low-voltage (120 to 600 V) power distribution and control equipment.

B. Related Requirements:

1. Section 26 2413 "Switchboards" for factory-installed SPDs.

2. Section 26 2416 "Panelboards" for factory-installed SPDs.

1.3 DEFINITIONS

A. Inominal: Nominal discharge current.

B. MCOV: Maximum continuous operating voltage.

C. Mode(s), also Modes of Protection: The pair of electrical connections where the VPR applies.

D. MOV: Metal-oxide varistor; an electronic component with a significant non-ohmic current-voltage characteristic.

E. OCPD: Overcurrent protective device.

F. SCCR: Short-circuit current rating.

G. SPD: Surge protective device.

H. VPR: Voltage protection rating.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

2. Copy of UL Category Code VZCA certification, as a minimum, listing the tested values for VPRs, Inominal ratings, MCOVs, type designations, OCPD requirements, model numbers, system voltages, and modes of protection.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Sample Warranty: For manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For SPDs to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency, and marked for intended location and application.

B. Comply with IEEE C62.41.2 and test devices according to IEEE C62.45.

C. Comply with NEMA LS 1.

D. Comply with UL 1283 and UL 1449, 3rd Edition.

E. Comply with NFPA 70.

1.8 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to replace or replace SPDs that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL SPD REQUIREMENTS

A. SPD with Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

C. Comply with UL 1449.

D. MCOV of the SPD shall be the nominal system voltage.

2.2 SERVICE ENTRANCE AND MAIN FEEDER SUPPRESSOR

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Current Technology Inc.; Danaher Power Solutions.

2. Eaton Corporation.

3. Emerson Electric Co.

4. GE Zenith Controls.

5. LEA International; Protection Technology Group.

6. Schneider Electric Industries SAS.

7. Siemens Industry, Inc.

B. SPDs: Comply with UL 1449, Type 1.

1. SPDs with the following features and accessories:

a. Integral disconnect switch.

b. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.

c. Indicator light display for protection status.

d. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status.

e. Surge counter.

2. Integral to service entrance equipment, factory installed. Device shall be installed in a separate compartment within the equipment that completely isolates the device upon failure to eliminate the spread of smoke within the service entrance equipment.

3. Separate enclosure for field installation outside of the service entrance equipment.

C. Comply with UL 1283.

D. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 240kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.

E. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V or 208Y/120 V, three-phase, four-wire circuits shall not exceed the following:

1. Line to Neutral: 1200 V for 480Y/277 V; 700 V for 208Y/120 V.

2. Line to Ground: 1200 V for 480Y/277 V; 1200 V for 208Y/120 V.

3. Line to Line: 2000 V for 480Y/277 V; 1000 V for 208Y/120 V.

F. SCCR: Equal or exceed 100 kA.

G. Inominal Rating: 20 kA.

2.3 PANEL SUPPRESSORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Current Technology Inc.; Danaher Power Solutions.

2. Eaton Corporation.

3. Emerson Electric Co.

4. GE Zenith Controls.

5. LEA International; Protection Technology Group.

6. Schneider Electric Industries SAS.

7. Siemens Industry, Inc.

B. SPDs: Comply with UL 1449, Type 1.

1. Include LED indicator lights for power and protection status.

2. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.

3. Include Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status.

4. Integral to service entrance equipment, factory installed. Device shall be installed in a separate compartment within the equipment that completely isolates the device upon failure to eliminate the spread of smoke within the service entrance equipment.

5. Separate enclosure for field installation outside of the service entrance equipment.

C. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 100 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.

D. Comply with UL 1283.

E. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V or 208Y/120 V, three-phase, four-wire circuits shall not exceed the following:

1. Line to Neutral: 1200 V for 480Y/277 V; 700 V for 208Y/120 V.

2. Line to Ground: 1200 V for 480Y/277 V; 1200 V for 208Y/120 V.

3. Line to Line: 2000 V for 480Y/277 V; 1000 V for 208Y/120 V.

F. Protection modes and UL 1449 VPR for 240/120-V, single-phase, three-wire circuits shall not exceed the following:

1. Line to Neutral: 700 V.

2. Line to Ground: 700 V.

3. Neutral to Ground: 700 V.

4. Line to Line: 1200 V.

G. SCCR: Equal or exceed 100 kA.

H. Inominal Rating: 20 kA.

2.4 ENCLOSURES

A. Indoor Enclosures: NEMA 250, Type 1.

B. Outdoor Enclosures: NEMA 250, Type 3R.

2.5 CONDUCTORS AND CABLES

A. Power Wiring: Same size as SPD leads, complying with Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables."

B. Class 2 Control Cables: Multiconductor cable with copper conductors not smaller than No. 18 AWG, complying with Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cables: Multiconductor cable with copper conductors not smaller than No. 14 AWG, complying with Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Install an OCPD or disconnect as required to comply with the UL listing of the SPD.

C. Install SPDs with conductors between suppressor and points of attachment as short and straight as possible, and adjust circuit-breaker positions to achieve shortest and straightest leads. Do not splice and extend SPD leads unless specifically permitted by manufacturer. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.

D. Use crimped connectors and splices only. Wire nuts are unacceptable.

E. Wiring:

1. Power Wiring: Comply with wiring methods in Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables."

2. Controls: Comply with wiring methods in Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables."

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative.

1. Compare equipment nameplate data for compliance with Drawings and Specifications.

2. Inspect anchorage, alignment, grounding, and clearances.

3. Verify that electrical wiring installation complies with manufacturer's written installation requirements.

B. An SPD will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.3 STARTUP SERVICE

A. Complete startup checks according to manufacturer's written instructions.

B. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests, and reconnect them immediately after the testing is over.

C. Energize SPDs after power system has been energized, stabilized, and tested.

3.4 DEMONSTRATION

A. Train Owner's maintenance personnel to operate and maintain SPDs.

END OF SECTION 26 43 13

SECTION 26 5100

INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Interior lighting fixtures, lamps, and ballasts.
2. Emergency lighting units.
3. Exit signs.
4. Lighting fixture supports.

B. Related Sections:

1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
2. Section 260936 "Modular Dimming Controls" for architectural dimming systems.
3. Section 260943.13 "Addressable-Fixture Lighting Controls" and Section 260943.23 "Relay-Based Lighting Controls" for manual or programmable control systems with low-voltage control wiring or data communication circuits.
4. Section 262726 "Wiring Devices" for manual wall-box dimmers for incandescent lamps.

1.3 DEFINITIONS

A. BF: Ballast factor.

B. CCT: Correlated color temperature.

C. CRI: Color-rendering index.

D. HID: High-intensity discharge.

E. LER: Luminaire efficacy rating.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting fixture, including ballast housing if provided.

1.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:

1. Physical description of lighting fixture including dimensions.
2. Emergency lighting units including battery and charger.
3. Ballast, including BF.
4. Energy-efficiency data.
5. Air and Thermal Performance Data: For air-handling lighting fixtures. Furnish data required in "Action Submittals" Article in Section 233713 "Diffusers, Registers, and Grilles."
6. Sound Performance Data: For air-handling lighting fixtures. Indicate sound power level and sound transmission class in test reports certified according to standards specified in Section 233713 "Diffusers, Registers, and Grilles."
7. Life, output (lumens, CCT, and CRI), and energy-efficiency data for lamps.
8. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing & Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.
    a. Testing Agency Certified Data: For indicated fixtures, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining fixtures shall be certified by manufacturer.
    b. Manufacturer Certified Data: Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. If project is LEED Certified or to be LEED Certified, product data submittals shall also include the following information and highlighted in submittal:

1. Luminance Chart/Graph showing fixture utilizes less than 7500 cd/m^2 between 45 and 90 degree from nadir.
    a. Exceptions include wall wash and indirect only type fixtures.
2. Unified glare rating
3. CRI of 80 or higher
    a. Exceptions include site lighting, accent or colored lighting
4. Rated life, L70, of at least 24,000 hours

C. Finish and Color Submittal: Provide a complete finish and color submittal package with all finish and color options for each fixture available for the project. Architect shall provide selections based on this separate submittal.

D. Shop Drawings: For nonstandard or custom lighting fixtures. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

2. Wiring Diagrams: For power, signal, and control wiring.

E. Seismic Qualification Certificates: For lighting fixtures, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

F. Samples: For each lighting fixture indicated in the Interior Lighting Fixture Schedule. Each Sample shall include the following:

1. Lamps and ballasts, installed.

2. Cords and plugs.

3. Pendant support system.

G. Installation instructions.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Lighting fixtures.

2. Suspended ceiling components.

3. Partitions and millwork that penetrate the ceiling or extends to within 12 inches (305 mm) of the plane of the luminaires.

4. Ceiling-mounted projectors.

5. Structural members to which suspension systems for lighting fixtures will be attached.

6. Other items in finished ceiling including the following:

a. Air outlets and inlets.

b. Speakers.

c. Sprinklers.

d. Smoke and fire detectors.

e. Occupancy sensors.

f. Access panels.

7. Perimeter moldings.

B. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, from manufacturer.

C. Field quality-control reports.

D. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.

1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fixtures/Lamps: 5 for every 100 of each type and rating installed. Furnish at least one of each type.

2. Plastic Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.

3. LED-fixture-mounted, emergency battery pack: One for every 20 emergency lighting unit.

4. Drivers: One for every 100 of each type and rating installed. Furnish at least one of each type.

5. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

1.8 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NFPA 70.

D. FM Global Compliance: Lighting fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

E. Mockups: Provide interior lighting fixtures for room or module mockups complete with power and control connections.

1. Obtain Architect's approval of fixtures for mockups before starting installations.

    a. All Pendant lighting shall be mocked up in the space with an individual fixture and approval of suspension height from architect prior to any other similar installation.

2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.

3. Approved fixtures in mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.10 WARRANTY

A. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Emergency Lighting Unit Batteries: 10 years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining nine years.

2. Warranty Period for Emergency Ballast and Self-Powered Exit Sign Batteries: Seven years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining six years.

3. Acrylic Lenses, Anti-Yellowing: 5 years from date of Substantial Completion if acrylic lenses have any noticeable sign of yellowing.

4. Warranty Period for LED Luminaires: 5 years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining 4 years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the products indicated.

2.2 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

B. Metal Parts: Free of burrs and sharp corners and edges.

C. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.

D. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to

prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

E. Diffusers and Globes:

1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

a. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.

b. UV stabilized.

2. Glass: Annealed crystal glass unless otherwise indicated.

2.3 LED LAMPS AND DRIVERS

A. Approved Manufacturers for Luminaires shall be as scheduled.

B. Approved Manufacturers- LEDs

1. General Electric

2. Philips

3. Osram

4. Cree

5. Xicato

6. Nichia

C. Approved Manufacturers- Drivers

1. General Electric.

2. Philips.

3. Osram / Sylvania.

4. Lutron

5. EldoLED

6. Thomas Research

D. Lumen output shall be Luminaire Lumens or Delivered Lumens. Source lumens shall not be used, per IES LM-79 and LM-80.

E. Inrush current shall be negligible. Maximum allowed is 30mAs.

F. THD: THD shall not exceed 20% at full load.

G. Minimum driver efficiency shall be 86% at 65% rated load.

H. Maximum off-state power consumption 0.5w.

I. Compliant with FCC 47 CFR Part 15 A for Residential applications and B for Commercial applications.

J. Luminaire shall be NRTL Listed at intended operating temperature.

K. Photometry shall be measured or absolute photometry. Derived or calculated photometry shall not be provided for consideration.

L. Drivers for Solid State Lighting Sources: Comply with UL 8750 and be so recognized.

M. Ballast Circuit: Constant-current or constant voltage as required by the LED assembly.

N. High power factor >.90

O. Driver and Led modules shall operate the solid state light source in a constant manner, performing without measurable flicker below 25kHz along entire range of dimming.

P. Minimum Starting Temperature: Minus 22 deg F (Minus 30 deg C).

Q. Rated and UL / ETL tested ambient operating temperature:104 deg F (40 deg C).

R. CRI (Ra) shall be based on CIE/IES definition using 8 color criteria. Comply with R9 value, if specified. Minimum CRI Ra- 82 or as specified.

S. Individual LEDs shall be tested in compliance with IES LM-79-08. The complete LM-79 report shall be available if requested.

T. Chromaticity tolerance shall be 2 MacAdam ellipses for interior applications and 6 MacAdam Ellipses for exterior applications. Rating shall be by ANSI/NEMA C78.377-2008.

U. Rated life shall be as determined by IES LM-80-08 and IES TM-21-11. These full reports shall be available if requested.

V. Only original Absolute Photometry in compliance with IES LM-79-08 shall be used to report solid state luminaire performance. Derived files are not acceptable.

W. Do not exceed scheduled drive current. Open-circuit operation that will not reduce driver life.

X. Dimming by DMX, DALI, PWM or CCR methods are approved, must be compatible with the control systems on the projects. Dimming range shall be from 100% to 1% of measured light output.

Y. Dimming drivers shall be compatible with the control method shown on the drawings. All dimmed drivers shall use 0-10vdc control unless specified differently. Minimum level shall be 1% or as scheduled.

Z. Low-Noise Ballasts: manufacturers' standard epoxy-encapsulated or noise suppressed modules designed to minimize audible fixture noise.

AA. LED modules and drivers shall be replaceable in the field, LED modules shall have digitally traceable matching modules.

2.4 EXIT SIGNS

A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:

1. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.

2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.

a. Battery: Sealed, maintenance-free, nickel-cadmium type.

b. Charger: Fully automatic, solid-state type with sealed transfer relay.

c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.

d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.

e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

f. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.

g. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

3. Master/Remote Sign Configurations:

a. Master Unit: Comply with requirements above for self-powered exit signs, and provide additional capacity in LED power supply battery for power connection to remote unit.

b. Remote Unit: Comply with requirements above for self-powered exit signs, except omit power supply, battery, and test features. Arrange to receive full power requirements from master unit. Connect for testing concurrently with master unit as a unified system.

2.5 EMERGENCY LIGHTING UNITS

A. General Requirements for Emergency Lighting Units: Self-contained units complying with UL 924.

1. Battery: Sealed, maintenance-free, lead-acid type.

2. Charger: Fully automatic, solid-state type with sealed transfer relay.

3. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay

disconnects lamps from battery, and battery is automatically recharged and floated on charger.

4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.

5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

6. Wire Guard: Heavy-chrome-plated wire guard protects lamp heads or fixtures.

7. Integral Time-Delay Relay: Holds unit on for fixed interval of 15 minutes when power is restored after an outage.

8. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.

9. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

2.6 LIGHTING FIXTURE SUPPORT COMPONENTS

A. Comply with Section 260529 "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.

C. Twin-Stem Hangers: Two, 1/2-inch (13-mm) steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.

D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm).

E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage (2.68 mm).

F. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.

G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Lighting fixtures:

1. Set level, plumb, and square with ceilings and walls unless otherwise indicated.

2. Install lamps in each luminaire.

B. Temporary Lighting: If it is necessary, and approved by Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When

construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstall.

C. Remote Mounting of Ballasts: Distance between the ballast and fixture shall not exceed that recommended by ballast manufacturer. Verify, with ballast manufacturers, maximum distance between ballast and luminaire.

D. Lay-in Ceiling Lighting Fixtures Supports: Use grid as a support element.

1. Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each fixture. Locate not more than 6 inches (150 mm) from at least two diagonal corners of lighting fixture and attach to building structure.

2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.

3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch (20-mm) metal channels spanning and secured to ceiling tees.

4. Install at least one independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.

E. Suspended Lighting Fixture Support:

1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.

2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.

3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.

4. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.

5. Safety Cables: to prevent the fixture from falling if swaying breaks the pendant.

F. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.2 IDENTIFICATION

A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

B. Verify that self-luminous exit signs are installed according to their listing and the requirements in NFPA 101.

C. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.4 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting aimable luminaires to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose. Some of this work may be required after dark.

1. Adjust aimable luminaires in the presence of Architect.

END OF SECTION 26 51 00

SECTION 26 5600

EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Exterior luminaires with lamps and ballasts.

2. Poles and accessories.

B. Related Sections:

1. Division 26 Section "Interior Lighting" for exterior luminaires normally mounted on exterior surfaces of buildings.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color-rendering index.

C. HID: High-intensity discharge.

D. LER: Luminaire efficacy rating.

E. Luminaire: Complete lighting fixture, including ballast housing if provided.

F. Pole: Luminaire support structure, including tower used for large area illumination.

G. Standard: Same definition as "Pole" above.

1.4 STRUCTURAL ANALYSIS CRITERIA FOR POLE SELECTION

A. Dead Load: Weight of luminaire and its horizontal and vertical supports, and supporting structure, applied as stated in AASHTO LTS-4-M.

B. Live Load: Single load of 500 lbf (2224 N), distributed as stated in AASHTO LTS-4-M.

C. Ice Load: Load of 3 lbf/sq. ft. (145 Pa), applied as stated in AASHTO LTS-4-M Ice Load Map.

D. Wind Load: Pressure of wind on pole and luminaire and banners and banner arms, calculated and applied as stated in AASHTO LTS-4-M.

1. Basic wind speed for calculating wind load for poles 50 feet (15 m) high or less is 100 mph (45 m/s) with a 1.3 gust factor, and minimum design life of 30 years.

1.5 SUBMITTALS

A. Product Data: For each luminaire, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:

1. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.

2. Details of attaching luminaires and accessories.

3. Details of installation and construction.

4. Luminaire materials.

5. Photometric data based on laboratory tests of each luminaire type, complete with indicated lamps, ballasts, and accessories.

   a. Manufacturer Certified Data: Photometric data shall be certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

6. Ballasts, including energy-efficiency data.

7. Lamps, including life, output, CCT, CRI, lumens, and energy-efficiency data.

8. Materials, dimensions, and finishes of poles.

9. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.

10. Anchor bolts for poles.

11. Manufactured pole foundations.

B. Finish and Color Submittal: Provide a complete finish and color submittal package with all finish and color options for each fixture available for the project. Architect shall provide selections based on this separate submittal.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

2. Anchor-bolt templates keyed to specific poles and certified by manufacturer.

3. Design calculations, certified by a qualified professional engineer, indicating strength of screw foundations and soil conditions on which they are based.

4. Wiring Diagrams: For power, signal, and control wiring.

D. Pole and Support Component Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements in AASHTO LTS-4-M and that

load imposed by luminaire and attachments has been included in design. The certification shall be based on design calculations by a professional engineer.

E. Pole bases: Provide deferred submittal of pole base design signed and stamped by a structural engineer licensed in the state of Utah based on the project conditions and submitted pole and light combination.

F. Qualification Data: For qualified agencies providing photometric data for lighting fixtures.

G. Field quality-control reports.

H. Operation and Maintenance Data: For luminaires and poles to include in emergency, operation, and maintenance manuals.

I. Warranty: Sample of special warranty.

1.6 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with IEEE C2, "National Electrical Safety Code."

D. Comply with NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Package aluminum poles for shipping according to ASTM B 660.

B. Store poles on decay-resistant-treated skids at least 12 inches (300 mm) above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.

C. Retain factory-applied pole wrappings on metal poles until right before pole installation. For poles with nonmetallic finishes, handle with web fabric straps.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.

1. Warranty Period for Luminaires including LED’s: Five years from date of Substantial Completion.

2. Warranty Period for Metal Corrosion: Five years from date of Substantial Completion.

3. Warranty Period for Color Retention: Five years from date of Substantial Completion.

4. Warranty Period for Poles: Repair or replace lighting poles and standards that fail in finish, materials, and workmanship within manufacturer's standard warranty period, but not less than three years from date of Substantial Completion.

1.9 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps: One for every 10 of each type and rating installed. Furnish at least one of each type.

2. Glass and Plastic Lenses, Covers, and Other Optical Parts: One for every 20 of each type and rating installed. Furnish at least one of each type.

3. Ballasts: One for every 10 of each type and rating installed. Furnish at least one of each type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the products indicated.

2.2 GENERAL REQUIREMENTS FOR LUMINAIRES

A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.

1. LER Tests Incandescent Fixtures: Where LER is specified, test according to NEMA LE 5A.

2. LER Tests Fluorescent Fixtures: Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.

3. LER Tests HID Fixtures: Where LER is specified, test according to NEMA LE 5B.

B. Lateral Light Distribution Patterns: Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.

C. Metal Parts: Free of burrs and sharp corners and edges.

D. Sheet Metal Components: Corrosion-resistant aluminum unless otherwise indicated. Form and support to prevent warping and sagging.

E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.

F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.

G. Exposed Hardware Material: Stainless steel.

H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

I. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.

J. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:

1. White Surfaces: 85 percent.

2. Specular Surfaces: 83 percent.

3. Diffusing Specular Surfaces: 75 percent.

K. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

L. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

M. Factory-Applied Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."

2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.

a. Color: As selected by Architect from manufacturer's full range.

N. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20; and seal aluminum surfaces with clear, hard-coat wax.

3. Class I, Color Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.

a. Color: As selected by Architect from manufacturer's full range.

O. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp and ballast characteristics:

a. "USES ONLY" and include specific lamp type.

b. Lamp diameter code (T-4, T-5, T-8, T-12), tube configuration (twin, quad, triple), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.

c. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.

d. Start type (preheat, rapid start, instant start) for fluorescent and compact fluorescent luminaires.

e. ANSI ballast type (M98, M57, etc.) for HID luminaires.

f. CCT and CRI for all luminaires.

P. Exterior Lighting Fusing:

1. Manufacturer:

a. Cooper Bussman.

1) Type: KTK-6, 6A 600V.

2) Fuse Holder: HEB-JJ in-line with rubber insulating boots.

3) Note: Crimp style fuses shall not be allowed.

2. Each fixture shall have fusing inside of hinged pole base.

3. Fusing shall be provided for each ungrounded conductor.

2.3 LED LAMPS AND DRIVERS:

A. Minimum CRI Ra- 82 or as specified.

B. Lumen output shall be Luminaire Lumens or Delivered Lumens. Source lumens shall not be used, per IES LM-79 and LM-80.

C. Color Consistency 3 MacAdams Ellipse or better.

D. LED Rated life L70 of 50,000 hours per (IES TM-21). Luminaire shall maintain LED operating temperature to achieve this rating per TM-21.

E. Flicker: No visible or detectable flicker, operating on all dimmed intensities.

F. Dimming drivers shall be compatible with the control method shown on the drawings. All dimmed drivers shall use 0-10vdc control unless specified differently. Minimum level shall be 1% or as scheduled.

G. Inrush current shall be negligible. Maximum allowed is 30mAs.

H. THD: THD shall not exceed 10% at full load.

I. Minimum driver efficiency shall be 86% at 65% rated load.

J. Maximum off-state power consumption 0.5w.

K. Compliant with FCC 47 CFR Part 15 A for Residential applications and B for Commercial applications.

L. LED module shall be replaceable in the field using modules with digitally traceable matching modules.

M. Luminaire shall be NRTL Listed at intended operating temperature.

N. Photometry shall be measured or absolute photometry. Derived or calculated photometry shall not be provided for consideration.

O. Approved Manufacturers- Drivers

1. General Electric.
2. Philips.
3. Osram / Sylvania.
4. Lutron
5. EldoLED
6. Thomas Research

P. Approved Manufacturers- LEDs

1. General Electric
2. Philips
3. Osram
4. Cree
5. Xicato
6. Nichia

2.4 GENERAL REQUIREMENTS FOR POLES AND SUPPORT COMPONENTS

A. Structural Characteristics: Comply with AASHTO LTS-4-M.

1. Wind-Load Strength of Poles: Adequate at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of speed indicated in "Structural Analysis Criteria for Pole Selection" Article.
2. Strength Analysis: For each pole, multiply the actual equivalent projected area of luminaires and brackets by a factor of 1.1 to obtain the equivalent projected area to be used in pole selection strength analysis.

B. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts unless otherwise indicated.

C. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.

1. Materials: Shall not cause galvanic action at contact points.

2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.

3. Anchor-Bolt Template: Plywood or steel.

D. Handhole: Oval-shaped, with minimum clear opening of 2-1/2 by 5 inches (65 by 130 mm), with cover secured by stainless-steel captive screws.

E. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete."

F. Breakaway Supports: Frangible breakaway supports, tested by an independent testing agency acceptable to authorities having jurisdiction, according to AASHTO LTS-4-M.

G. Hinged Bases:

1. Manufacturer: Subject to compliance with requirements, provide products by one of the following:

a. Sterner Lighting; Hubble Lighting.

b. LSI Industries, inc.

2. The folding direction of hinged base shall allow for a full 90 degree tilt.

2.5 STEEL POLES

A. Poles: Comply with ASTM A 500, Grade B, carbon steel with a minimum yield of 46,000 psig (317 MPa); one-piece construction up to 40 feet (12 m) in height with access handhole in pole wall.

1. Shape: As indicated.

2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.

3. Hinged pole base assembly where indicated.

B. Steel Mast Arms: configurations and types indicated, continuously welded to pole attachment plate. Material and finish same as pole.

C. Brackets for Luminaires: Detachable, cantilever, without underbrace.

1. Adapter fitting welded to pole, allowing the bracket to be bolted to the pole mounted adapter, then bolted together with stainless-steel bolts.

2. Cross Section: Tapered oval, with straight tubular end section to accommodate luminaire.

3. Match pole material and finish.

D. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.

E. Grounding and Bonding Lugs: Welded 1/2-inch (13-mm) threaded lug, complying with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.

F. Cable Support Grip: Wire-mesh type with rotating attachment eye, sized for diameter of cable and rated for a minimum load equal to weight of supported cable times a 5.0 safety factor.

G. Factory-Painted Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or with SSPC-SP 8, "Pickling."

2. Interior Surfaces of Pole: One coat of bituminous paint, or otherwise treat for equal corrosion protection.

3. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.

a. Color: As selected by Architect from manufacturer's full range.

2.6 ALUMINUM POLES

A. Poles: Seamless, extruded structural tube complying with ASTM B 429/B 429M, Alloy 6063-T6 with access handhole in pole wall.

1. Shape: as indicated.

2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.

B. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.

C. Grounding and Bonding Lugs: Welded 1/2-inch (13-mm) threaded lug, complying with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.

D. Brackets for Luminaires: Detachable, with pole and adapter fittings of cast aluminum. Adapter fitting welded to pole and bracket, then bolted together with stainless-steel bolts.

1. Tapered oval cross section, with straight tubular end section to accommodate luminaire.

2. Finish: Same as pole and luminaire.

E. Aluminum Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20; and seal aluminum surfaces with clear, hard-coat wax.

3. Class I, Color Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.

a. Color: As selected by Architect from manufacturer's full range.

2.7 POLE ACCESSORIES

A. Base Covers: Manufacturers' standard metal units, arranged to cover pole's mounting bolts and nuts. Finish same as pole.

PART 3 - EXECUTION

3.1 LUMINAIRE INSTALLATION

A. Install lamps in each luminaire.

B. Fasten luminaire to indicated structural supports.

1. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

C. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.

D. [Where existing pole lights are specified to be removed and/or relocated, the Contractor shall replace lost or damaged lights and/or poles with new equipment at no additional cost to the Owner].

3.2 POLE INSTALLATION

A. Alignment: Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on the pole.

B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features unless otherwise indicated on Drawings:

1. Fire Hydrants and Storm Drainage Piping: 60 inches (1520 mm).

2. Water, Gas, Electric, Communication, and Sewer Lines: 10 feet (3 m).

3. Trees: 15 feet (5 m) from tree trunk.

C. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are specified in Division 03 Section "Cast-in-Place Concrete."

D. Foundation-Mounted Poles: Mount pole with leveling nuts, and tighten top nuts to torque level recommended by pole manufacturer.

1. Use anchor bolts and nuts selected to resist seismic forces defined for the application and approved by manufacturer.

2. Grout void between pole base and foundation. Use nonshrink or expanding concrete grout firmly packed to fill space.

3. Install base covers unless otherwise indicated.

4. Use a short piece of 1/2-inch- (13-mm-) diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.

E. Poles and Pole Foundations Set in Concrete Paved Areas: Install poles with minimum of 6-inch- (150-mm-) wide, unpaved gap between the pole or pole foundation and the edge of adjacent concrete slab. Fill unpaved ring with pea gravel to a level 1 inch (25 mm) below top of concrete slab.

F. Raise and set poles using web fabric slings (not chain or cable).

G. Hinged Pole Bases:

1. Install hinged pole base on each pole light.

H. Hinge direction shall not be directed onto a slope or into traffic.

3.3 BOLLARD LUMINAIRE INSTALLATION

A. Align units for optimum directional alignment of light distribution.

B. Install on concrete base with top 2-3 inches (50 mm) above finished grade or surface at bollard location. Cast conduit into base, and shape base to match shape of bollard base with a 2-3 inch reveal around bollard. Finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Section 033000 "Cast-in-Place Concrete."

3.4 INSTALLATION OF INDIVIDUAL GROUND-MOUNTING LUMINAIRES

A. Install on concrete base with top 4 inches (100 mm) above finished grade or surface at luminaire location. Cast conduit into base, and finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Division 03 Section "Cast-in-Place Concrete."

3.5 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

B. Steel Conduits: Comply with Division 26 Section "Raceway and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- (0.254-mm-) thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.6 GROUNDING

A. Ground metal poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

1. Install grounding electrode for each pole unless otherwise indicated.

2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

3. Copper-clad ground rods shall not be installed under concrete pole base.

3.7 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.

1. Verify operation of photoelectric controls.

C. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION 26 56 00

SECTION 27 05 10
BASIC REQUIREMENTS FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section and other Division 27 sections.

1.02 SUMMARY

A. This contractor shall be responsible for providing the complete installation of systems and components specified in all Division 27 sections. Systems included in this technology package include, but are not limited to, the following:
   1. Communications Systems:
      a. Data and voice communications distribution systems.
      b. Satellite and off air antenna video distribution systems.
      c. Audio/Visual systems.
      d. Local Sound Reinforcement systems.

B. Work Provided by Others (not-in-contract):
   1. Unless otherwise noted, rough-in work for cabling, including boxes, conduits, sleeves, and cable tray are provided under Division 26.
   2. Network routers, hubs, switches, UPS's and rack mount power strips are supplied and configured by owner.
   3. Telephone system.
   4. A/V equipment including video displays and projectors.

C. This contractor shall furnish and install all material specified or described herein and as shown on the plans to provide complete and operating systems. Include supporting devices, accessories, and assemblies, including cable supports, cable runways, and any additional rough-in and pathways as necessary or as noted. The contractor shall provide all necessary configuration of each installed system according to the owner' s requirements, unless noted otherwise.

1.03 BASIC INSTRUCTION

A. Before bidding, the Contractor shall diligently study and compare all contract documents and shall promptly report to the Architect/Engineer any discrepancies or deficiencies discovered by or made known to the Contractor.

B. Discrepancies: Whenever a discrepancy or inconsistency exists between related information indicated on the contract drawings and/or specifications (such as differences between product descriptions and catalog numbers) this contractor shall obtain additional clarification and direction from the Architect/Engineer before proceeding. For bidding purposes, this contractor shall include the labor and materials necessary to comply with the alternative that results in the greatest cost to the Contract.

C. Deficiencies: The Contractor and subcontractors shall resolve all known deficiencies and omissions, including non-compliance with applicable codes, with the Architect/Engineer prior to ordering materials or proceeding with the work. Any work performed prior to receipt of instruction from the Architect/Engineer will be done so at the Contractor’s risk.

D. Manufacturer’s Catalog Numbers: Product series, model, or catalog numbers, whether indicated on drawings or specifications, shall not be considered complete. This Contractor shall not order any product based solely upon the stated catalog number. Furnish products including accessories and options necessary to match the full product description and its intended purpose and application based on all information available from the contract documents.

1.04 DEFINITIONS

A. Provide: The term “provide” means “to furnish and install, ready for the intended use and in complete operating condition”.

B. Install: The term “install” is used to describe operations at project site including the actual “unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations”.

C. BICSI: Building Industry Consulting Service International.

D. IT: Information technology.

E. LAN: Local area network.

F. LEC: Local Exchange Carrier.

G. NEC: National Electrical Code (NFPA 70).

H. POT: Point of Termination.

I. RCDD: Registered Communications Distribution Designer.

J. UTP: Unshielded twisted pair.

1.05 CODES, PERMITS, AND FEES

A. Comply with all applicable laws, ordinances, rules, regulations, codes or rulings of governmental units having jurisdiction, as well as standards of the National Fire Protection Association and serving utility requirements.

1. Electrical installations within IT equipment rooms shall comply with NEC Article 645.
2. IT equipment rooms containing communications equipment (electronic data processing equipment), such as in the main IT equipment room (Head-End) shall comply also with NEC Article 800.

B. Coordinate all permits, fees, inspections, utility connections and extensions and the like associated with work in each section of this Division. Utility installation charges or fees shall be paid directly by the contractor as part of this contract.

C. The Contractor shall procure all easements, permits, and right-of-ways on behalf of the Owner for all outside plant ducts and pathways. The costs of all easements, permits, and right-of-ways shall be included in the Contractor’s bid

D. Installation procedure, methods and conditions shall comply with the latest requirements of the Federal Occupational Safety and Health Act (OSHA).

1.06 CONTRACTOR EXPERIENCE

A. Submit evidence of successful completion of other operational systems of similar size, scope, and complexity upon Owner’s request, prior to awarding contract Indicate the following:

1. Names and locations of two previously installed systems and two most recently installed systems.
2. Scope description for each system.
3. Building engineer/technician contact information for each system.
4. Previous installation experiences.
5. At least two personal references for similar UTP and fiber installations.

B. Installer experience preference: System installer, including all technician journeymen and equipment operators, shall have a minimum of five (5) years of communications cabling experience and prior references of at least 5 projects of similar size, scope, and complexity.

C. Contractor shall be currently licensed to install low-voltage cabling systems in the state where the work is being performed.

D. Contractor shall meet manufacturer's requirements for the provision and installation of specified equipment.

E. The Contractor shall provide a complete list of personnel proposed to perform the work, listing their

qualifications and experience with the type and size of work required by the project.

F. The Contractor bidding on communication systems specified herein shall be certified by the product manufacturer to install, service, and warranty the specified product prior to the time of bid and throughout the duration of the installation; or, the bidding contractor shall utilize a sub-contractor(s) certified by the product manufacturer to install, service, and warranty the specified product. Manufacturer certifications shall not be project specific and should be valid for any and all projects completed by the Contractor. The Contractor shall send only qualified personnel to perform work under this section of work.

G. The Contractor shall provide copies of certificates for proof of manufacturer's training, manufacturer's certified installer, authorized distributor in the shop drawing submittal and at the request of the engineer to verify compliance with specification prior to recommendations for awarding bid.

H. The Contractor shall provide a complete list of personnel proposed to perform the work, listing their qualifications and experience with the type and size of work required by the project.

1.07 GUARANTEES AND WARRANTIES

A. Guarantee all material, equipment and workmanship for all sections under this Division in writing to be free from defects of material and workmanship for not less than 12 months from the established Date of Substantial Completion, unless specifically noted elsewhere to be longer than one year, as outlined in the General Conditions. Replace without charge any material or equipment proving defective during this period. The guarantee shall include performance of equipment under all conditions of load, installing any additional items of control and/or protective devices as required.

B. All cabling shall be tested and certified. All UTP cabling shall meet the minimum requirements listed in section 27 16 00 - Testing of communications systems, part 3.2.B.

C. Refer to individual sections for additional guarantee and/or warranty requirements.

1.08 SUBMITTALS

A. General: Follow the procedures specified in Division 01 Section "Submittals". Additional submittal copies may be requested or required by the Architect/Engineer for specific sections of these specifications.

B. No part of the work requiring a submittal shall be commenced until the submittal has been approved by the Architect/Engineer. Any related work performed before approval shall be at Contractor's risk.

C. Qualifications:

1. Submit documentation of qualifications as specified in individual Sections.
2. Submit documentation of experience as specified in this Section.

D. Prior Approvals:

1. Submit for prior approval on Substitution Request Forms. Only written requests on these forms with complete submittal data will be considered.
2. Refer to each Section for specific submittal requirements.
3. Final approval of all equipment and materials shall be determined during shop drawing review. Any changes required due to substitution are entirely the Contractor's responsibility (and therefore shall not add any cost to the contract).

E. Shop Drawings:

1. Prior to submitting shop drawings, the Contractor shall review them and signify by stamping and initialing, compliance with plans and specifications and for dimensional suitability for each application. If any deviation from the specified criteria for any item of material exists, such deviation shall be stated in writing and incorporated with the shop drawings submittal. Review of shop drawings by the Architect shall not constitute agreement of any deviations from the plans and specifications unless such deviations are as specifically listed as required above, and such deviations accepted. Review of shop drawings by the Architect shall not relieve the Contractor from responsibility for errors or omissions in them.

2. Prepare and submit all required shop drawings at one time. Unless given approval by the Architect/Engineer, piecemeal submittals will be unacceptable.
3. The complete shop drawings shall be provided in electronic (PDF) format as well as a printed copy, bound neatly in hard cover, 3-ring binders.

F. Record Documents (“As-Built” Drawings)
1. Prepare and submit record documents in accordance with the requirements in Division 01 Section “Project Closeout”.
2. Maintain a contract set of record drawings at the site. Neatly mark all changes and deviations from the original drawings. Use a color that contrasts with the prints. This shall be a separate set of drawings, not used for construction purposes, and shall be kept up-to-date as the job progresses. This set shall be made available for inspection by the Architect/Engineer at the job site and submitted for final review prior to project closeout.

G. Cabling Administration Drawings:
1. Show building floor plans with cable administration point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606. Furnish electronic record of all drawings, in the software and format selected by Owner.
2. See Division 01 Section, “CAD Electronic Media Transfer Agreement” for obtaining AutoCAD files from the Architect and for associated request form and fees.
3. Submit final cabling administration drawings to Engineer for review prior to posting on wall in Main IT equipment room (Head-End).

H. Maintenance Manuals:
1. Prepare maintenance manuals in accordance with Division 01 Section "Project Closeout." In addition to the requirements specified in Division 1, include information as required in all Division 27 sections and the following:
a. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
b. Parts list.
c. Servicing instructions and schedules.
d. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; and summer and winter operating instructions.
e. All applicable warranty certificates and associated documentation.
2. Include copy of Record Documents in Maintenance Manuals.

I. Extra Materials:
1. Submit a signed copy a delivery receipt for spare materials provided, listing each item and its quantity. Differentiate between station cords, patch cords, and various lengths, for example.

1.09 COORDINATION

A. All drawings, specifications and documents for this project shall be taken as a whole. Before undertaking each part of the Work, carefully review and compare all documents pertaining to this project. This contractor shall take into consideration ceiling heights, ceiling types, structural components, mechanical equipment, and other field conditions that may impact the installation and installation costs.

B. Coordinate arrangement, mounting, and support of communications equipment:
1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other

installations.

3. To allow right of way for piping and conduit installed at required slope.
4. So connecting pathways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
5. In preparation of the contract documents, a reasonable effort has been made to provide layouts based on the selected and specified manufacturers equipment. Since space requirements and equipment arrangement vary according to manufacturer, the final responsibility for initial access and proper fit rests with the Contractor.

C. Coordinate phasing of work with the General Contractor to organize materials and resources to meet the scheduled completion dates indicated.
1. Where the installation of one part of the Work is dependent on the installation of other components, either before or after its own installation, schedule construction activities in the sequence required to obtain the best results. As necessary, prepare dated memoranda and distribute to each party involved, outlining special procedures required for coordination of their Work.

D. Conduct pre-installation conference at project site.

E. Coordinate backbone cable lengths with pathways including underground pathways.

F. Coordinate work with ceiling grid installation by others. Insure that scope of work includes possible cable installation delays and construction coordination with the work of other trades including installed lay in ceilings.

G. Coordinate location of access panels and doors for communications items that are behind finished surfaces or otherwise concealed.

H. Coordinate sleeve selection and application with selection and application of firestopping.
1. Coordinate the installation of firestopping compounds with other trades to facilitate the timely progress of work.

1.10 PROJECT CONDITIONS

A. Environmental Limitations: Do not install cable until construction in spaces is complete and ambient temperature and humidity conditions are maintained as indicated below, in referenced standards and in manufacturer's written instructions.
1. Temperature: MDF & IDF should be designed to maintain temperatures between range of 64 degrees and 75 degrees Fahrenheit. One air change per hour is required.

PART 2 PRODUCTS

2.01 SLEEVES FOR PATHWAYS AND CABLES

A. Unless otherwise noted, sleeves and pathways are provided under Division 26 (by electrical contractor).

B. Where additional conduits are needed beyond those shown on the drawings to accommodate the installation of systems cabling, this contractor shall include such provisions in this contract. Provide conduit suitable for its application and sized in accordance with the National Electrical Code (40% fill capacity). Install conduit in accordance with industry standards. Holes in masonry shall be made with rotary drills; impact tools are not permitted. Never penetrate through structural members or architectural finishes without prior approval from the architect or engineer. All penetration work shall be patched, sealed, cleaned, and returned to original conditions. Include nylon bushings at conduit ends and firestopping as required wherever building barriers are penetrated. If necessary, this contractor shall hire a qualified contractor to perform this work.

C. This communications contractor is responsible for creating a waterproof seal in and around openings to the building exterior created by or used by the communications contractor. All waterproof sealing materials shall comply with appropriate codes and shall be installed in accordance with manufacturer’s instructions.

PART 3 EXECUTION

3.01 COMMON REQUIREMENTS FOR COMMUNICATIONS INSTALLATION

A. Comply with NECA 1.

B. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

C. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both communications equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

D. Right of Way: Give to piping systems installed at a required slope.

E. The communications contractor shall clean up all debris related to Division 27 work on a regular basis leaving the job site in a clean, safe condition.

F. Ground (grass and soil conditions) disturbed by the installation of buried communications cabling and duct shall be restored to the original condition or better than original condition. Grass, plants, trees, and shrubs shall be restored when damaged; grass shall be seeded or replaced with sod when necessary. The contractor shall be responsible for watering areas of new seed and sod when natural rain is insufficient for good growth.

G. The low voltage contractor is responsible for closing ceiling tiles that they have opened (be mindful of the directional arrows, check with the superintendent for proper orientation).

3.02 FIRESTOPPING

A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for communications installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

3.03 GROUNDING

A. Grounding Bars: Provided under Division 26.

B. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.

C. A licensed electrician shall perform all grounding and bonding.

D. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

E. Comply with ANSI-J-STD-607-A and TIA-942.

F. Provide permanent and effective equipment grounding/bonding for technology systems equipment. Connections shall be tightened in accordance with the torque values specified in UL Standard 486A.

G. Bond each equipment rack together and to the ground reference point (ground bar) using a green #4 AWG copper conductor.

1. Make connections using listed compression connectors.
2. Bond other metallic equipment in IT equipment rooms to the grounding bus/bar, using not smaller than No. 6 AWG equipment grounding conductor.
3. All metallic raceways, cable runways, ladder racks, cable trays, and other metal objects shall be bonded together and connected to a grounding bus/bar in the equipment room.
4. Bond the shield of shielded cable to the grounding bus/bar in IT equipment rooms and spaces.
5. Flooring in MDF should be tiled and anti-static protection shall be taken as required by equipment. The copper ribbon should extend 3ft into flooring and grounded to ground bus bar.

H. The grounding system shall be a complete system including all necessary components, including lock washers, hex nuts, compression lugs, insulators, mounting screws, lugs, and other grounding hardware.

I. Refer to individual Sections for additional requirements.

3.04 IDENTIFICATION

A. Obtain actual room numbers from Owner prior to labeling. Room numbers shown on the contract drawings may not be the final room numbers and therefore shall not be used for labeling. Cabling

administration drawings shall indicate actual room numbers, but may indicate both actual room numbers and floor plan number.

B. Use logical and systematic designations for facility's architectural arrangement. Coordinate labeling schemes with owner prior to implementation.

C. Cable Schedule: Provide documents in 3-ring binder and hang from terminal board next to Cabling Administration Drawings in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Furnish an electronic copy of final comprehensive schedules for Project, in software and format acceptable to Owner.

D. Cabling Administration Drawings:

1. Develop Cabling Administration Drawings for system identification, testing, and management. Use unique, alphanumeric designation for each cable and label cable, jacks, connectors, and terminals to which it connects with same designation.
2. Prepare building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for each technology/telecommunications closet (TC-#), backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings, in software and format acceptable to Owner.
3. Post final cabling administration drawings (after review by Engineer) on wall in a prominent location in the Main IT equipment room (Head-End). Provide clear acrylic covering (Plexiglass or equivalent) and attach with screws to a painted plywood terminal board.

E. Final labeling shall include: face of patch panel, cable end behind patch panel, cable end within j-box, and faceplate. All terminations and all cables ends on every system shall be labeled.

F. Labeling shall be in accordance with owner requirements.

G. Refer to individual Sections for additional requirements.

3.05 QUALITY CONTROL

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements listed below.

B. Refer to individual Sections for requirements.

C. Submit test and inspection reports to Engineer for review.

D. Include Original and two (2) copies of warranty documents covering materials, installation, workmanship, and performance.

3.06 CLEANING AND PROTECTION

A. During the progress of the work, keep the premises clean and free of debris. Provide reasonable protection of the system from the normal activities of other workers on site and occupants of the facility.

B. Thoroughly clean all parts of the equipment prior to submittal for substantial completion.

3.07 SYSTEMS ADJUSTMENTS

A. Coordinate any selectable settings, adjustments, or programming with the Owner's representative prior to final commissioning of systems. Refer to individual Sections for any additional requirements.

3.08 FINAL ACCEPTANCE

A. All project review reports ("punchlists") submitted by the engineer shall be completed and signed by the Contractor prior to final project acceptance.

B. The Contractor shall schedule and conduct a final project review meeting with the Owner and Engineer to discuss the following items:

1. As-built CAD and PDF drawings must be provided by the low voltage cabling contractor on CD and submitted to LTF IT Telecommunication Engineer. Acceptable CAD format preferred is AutoCAD (DWG).drawings and documentation

2. Test results
3. Warranty and problem resolution procedures
4. Special maintenance procedures
5. A set of T-layer drawings (including bulletins, CCDs and change orders) must be kept and maintained onsite for reference during the construction process.
6. Address any questions of the Owner and Engineer.

C. The Contractor shall complete all additional training for the Owner as specified in other Division 27 specification sections.

END OF SECTION

SECTION 27 0800
COMMISSIONING OF COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. This section includes specific requirements that apply to the implementation of the Commissioning Process and this Division Contractors' participation in this process. This section details the project specific equipment and systems that are included in the Commissioning Process. For general descriptions and responsibilities, refer to SECTION 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

1.02 RELATED DOCUMENTS

A. The Owner's Project Requirements (OPR) document.

B. The Basis of Design (BoD) document.

C. The Project Commissioning Plan (CxP) document.

D. ASHRAE Standard 202-2013 - Commissioning Process for Buildings and Systems.

E. LEED v4 for Building Design and Construction.

1.03 RELATED SECTIONS

A. SECTION 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS

B. SECTION 07 08 00 - COMMISSIONING OF THERMAL AND MOISTURE PROTECTION

C. SECTION 08 08 00 - COMMISSIONING OF OPENINGS

D. SECTION 11 08 00 - COMMISSIONING OF EQUIPMENT

E. SECTION 13 08 00 - COMMISSIONING OF SPECIAL CONSTRUCTION

F. SECTION 14 08 00 - COMMISSIONING OF CONVEYING SYSTEMS

G. SECTION 21 08 00 - COMMISSIONING OF FIRE SUPPRESSION SYSTEMS

H. SECTION 22 08 00 - COMMISSIONING OF PLUMBING SYSTEMS

I. SECTION 23 08 00 - COMMISSIONING OF MECHANICAL SYSTEMS

J. SECTION 25 08 00 - COMMISSIONING OF INTEGRATED AUTOMATION SYSTEMS

K. SECTION 26 08 00 - COMMISSIONING OF ELECTRICAL SYSTEMS

L. SECTION 28 08 00 - COMMISSIONING OF SAFETY AND SECURITY SYSTEMS

M. SECTION 33 08 00 - COMMISSIONING OF UTILITIES

1.04 DEFINITIONS

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

1.05 RESPONSIBILITIES

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

PART 2 PRODUCTS

2.01 NO PRODUCTS SUPPLIED

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

B. Contractors and/or Vendors shall provide the specialty testing equipment necessary to fulfill the functional testing requirements, for the duration of the testing period.

PART 3 EXECUTION

3.01 GENERAL

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.02 MEETINGS

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.03 SYSTEM START-UP

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.04 PRE-FUNCTIONAL CHECKLISTS

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.05 FUNCTIONAL PERFORMANCE TESTING

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.06 TRAINING

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.07 SYSTEMS TO BE COMMISSIONED

A. GENERAL
   1. Commissioning specifications supplement the requirements of individual specifications sections but shall not be interpreted to replace or diminish the specified scope of any individual section.
   2. For all systems listed below, Division Contractor shall comply with all commissioning requirements specified.

B. APPLICABLE SYSTEMS
   1. Identification for Communications Systems
   2. Ambient Sound Distribution and Masking System
   3. Audio/Visual Systems and Displays
   4. Broadband Television Distribution System
   5. Video Surveillance
   6. Area of Refuge/Rescue Assistance Systems

END OF SECTION 27 0800

SECTION 27 11 00
COMMUNICATIONS EQUIPMENT ROOM FITTINGS AND PATHWAYS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:
   1. Technology mounting elements.
   2. Backboards.
   3. Technology equipment racks and cabinets.
   4. Cable management system.
   5. Telecommunications cabling pathways.
   6. Grounding.

1.03 DEFINITIONS

A. BICSI: Building Industry Consulting Service International.
B. Cable Runway: A fabricated structure consisting of a one-piece, ventilated-bottom or solid-bottom channel.
C. LAN: Local area network.
D. RCDD: Registered Communications Distribution Designer.
E. LEC: Local Exchange Carrier.

1.04 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for equipment racks and cabinets. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
   1. Submit data for each of the following components:
      a. Equipment racks.
      b. Cable runway.
      c. Horizontal and vertical wire management.
      d. J-hooks, D-rings, lacing bars, tie-wraps.
B. Shop Drawings: For communications equipment room fittings. Include plans, elevations, sections, details, and attachments to other work.
   1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   2. Equipment Racks and Cabinets: Include workspace requirements and access for cable connections.
   3. Cable runway layout in equipment rooms, showing routing to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
      a. Vertical and horizontal offsets and transitions.
      b. Clearances for access above and to the sides of cable runway.
      c. Vertical elevation of cable runways above the floor or bottom of ceiling structure.
      d. Load calculations to show dead and live loads as not exceeding the manufacturer's ratings for the cable runway and its support elements.

1.05 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements listed below.
B. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Lead Cable Installer must have five years of communications cabling experience and prior references of at least five projects of similar size, scope and complexity.
2. Installation Supervision: Installation shall be under the direct supervision of a Senior Technician or Level 2 Installer (or equivalent), who shall always be present when work of this section is performed at project site.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
D. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.
E.
F. Grounding: Comply with ANSI-J-STD-607-A.

1.06 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install equipment frames and cable trays until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and work above ceilings is complete.

1.07 COORDINATION

A. Coordinate layout and installation of communications equipment with Owner's telecommunications and LAN equipment and service suppliers. Coordinate service entrance arrangement with LEC.
1. Meet jointly with telecommunications and LAN equipment suppliers, LEC representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
2. Record agreements reached in meetings and distribute to other participants.
3. Adjust arrangements and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.
4. Adjust arrangements and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in the equipment room.

B. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

PART 2 PRODUCTS

2.01 PATHWAYS

A. General Requirements: Comply with TIA/EIA-569-A.
B. J-hooks: Steel, UL listed, ultimate static load limit 50 lbs. minimum. Wide base, beveled edges. Rated to support Category 6 cables, and optical fiber cables. Integral Velcro strap. If required, assemble to manufacturer recommended specialty fasteners including beam clips, flange clips, drop wire/rod, C and Z purlin clips.
1. Provide products manufactured by one of the following:
a. Chatsworth Products (CPI) # 31422-801 series.
b. Caddy by Erico, Inc.
c. B-line

C. Provide plenum rated velcro straps, length and strength as required to organize and bundle cables. Vinyl tie straps are prohibited throughout. Do not use vinyl to temporarily organize cables.
D. Existing building structure may be used to support cabling, if the structural members are smooth, free of burrs, and have adequate surface area to prevent deforming of cable jacket. Bundle cables with Velcro when utilizing existing structure for support. Coordinate with other trades for locations.
E. Cable Runways in Equipment Rooms:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
a. Cablofil Inc.

b. Chatsworth Products, Inc. (CPI)
c. CommScope
d. Cooper B-Line, Inc.
e. GS Metals Corp.
f. Hoffman (a Pentair Company).

2. Cable Runway Materials: Tubular steel cable runways made of 3/8-inch" x 1-1/2-inch x 0.065 wall rectangular welded sections, with welded cross members every 12-inches. Includes standard manufactured 90-degree sweeps, horizontal and vertical bends, cable drop-outs, mounting hardware, brackets and assemblies which shall be equivalent to owner preferred solutions, or approved equal in this section.
   a. 12" wide ladder rack. Black in color. CommScope Part #: CR-SLR-1OL12W.
   b. Wall angle support kit. Black in color. CommScope Part #: CR6-12WRSK.
   c. Four T-junction ladder brackets. CommScope Part #: CRTJSK.
   d. Butt-splice ladder clamps. CommScope Part #: CRBSK.
   e. Two ladder rack protective end caps. CommScope Part #: CRPECK.
   f. Cable runway 90 degree radius flat bend. CommScope Part #: CR90FCB-12W.
   g. Cable runway, rung drop out. CommScope Part #: CRDK-12W
   h. Runway to rack mounting kit. CommScope Part #: CRR2RRMK.

F. Conduit and Boxes: Provided under Division 26 (by electrical contractor), unless specifically noted otherwise. Where additional conduit and boxes are needed to comply with these specifications and drawings, this Contractor shall comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems." Flexible metal conduit shall not be used.

2.02 BACKBOARDS

A. Backboards (Terminal Boards):
1. ¾" fire rated plywood, painted to match adjacent finishes, with the fire rating stamp on each piece remaining visible (unpainted).

2.03 EQUIPMENT FRAMES/RACKS/CABINETS

A. Manufacturers: Subject to compliance with requirements, provide the following product or approved equal:
1. Hoffman (a Pentair Company).

B. Open Four-Post Adjustable Frame Requirements:
1. Freestanding, steel units designed for rack mounted server support and coordinated with dimensions of units to be supported.
2. Module Dimension: Width compatible with EIA 310 standard, 19-inch (480-mm) panel mounting.
3. Rack Height: Approximately 96 inches (2130 mm), providing a mounting space of 51 rack units (1 RU = 1¾"). Each mounting space shall be marked and numbered on the mounting channel.
4. Finish: Manufacturer's standard black, baked-polyester powder coat.
5. Cable Management:
   a. Vertical wire management devices: Approximately 6 or 10 inches wide as indicated by 4 inches deep double-sided, mounted either side of vertical rack frames. Provide with removable front and rear covers. Provide two (2) wire retainers for each 12 inches of duct. Basis of design: Hoffman # DV10D8 / DV06D8.
   b. Horizontal wire management devices: Horizontal distribution channel front only. Provide slotted wall wiring duct with hinged metal cover. 2 RMU tall by 8" deep. Basis of Design: Panduit # NCMHAEF2.
6. When assembled with top and bottom pans and angles, equipment-mounting channels will be spaced to allow attachment of 19" EIA rack-mount equipment.
7. Grounding lug.

8. Anchor to floor with four bolts. Anchor to wall with ladder rack.
9. Rack construction method shall ensure an electrically bonded structure for ease of grounding.
10. Alternating hole-pattern: 5/8” – 5/8” – 1/2”, compatible with EIA 1-1/4” – 1-1/2” alternating hole-patterns.
11. Quantities of Mounting Screws: Quantity needed to mount equipment plus 12 spare screws per rack.
12. Basis of Design: Hoffman E4DR19FM51U-96.00 x 20.25.

C. Swing Gate Wall Rack:
1. Wall mounted, extruded aluminum units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
2. Module Dimension: Width compatible with EIA 310 standard, 19-inch panel mounting.
3. Rack Height: Provide a mounting space of 25 rack units (1 RU = 1¾”). Each mounting space shall be marked and numbered on the mounting channel.
4. Finish: Manufacturer's standard black, baked-polyester powder coat.
5. Alternating hole-pattern: 5/8” – 5/8” – 1/2”, compatible with EIA 1-1/4” – 1-1/2” alternating hole-patterns.
6. Quantities of Mounting Screws: Quantity needed to mount equipment plus 12 spare screws per rack.
7. Grounding lug.
8. Basis of Design: Hoffman RW25-18
9. Dual hinges open to right or left stopping in 90-degree position.

2.04 UNDERGROUND DUCTS AND RACEWAYS FOR COMMUNICATIONS SYSTEMS AND SAFETY MEASURES

A. Removing Trench Duct Cover Plates:
1. Remove trench duct covers with suction cups lifter, Legrand part #485 or equivalent. Do not use screwdrivers.
2. When heavy material or equipment loads will be placed on or moved over the duct system, install temporary planking that will transfer loads to adjacent concrete

B. Trench Duct Safety:
1. A barricade must be placed a minimum of 6 feet around the opening of the Trench Duct.
2. A barricade could be made from wood with top rail of 42” AFF and middle rail of 21” AFF. Caution floor 36” safety cones with Danger Keep Out (red) tape could be used as well.
3. “Danger Due To” signs must be posted around barricade.
4. Communicate all safety barricades with superintendent.

2.05 GROUNDING

A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems." for grounding conductors and connectors.
B. Comply with ANSI-J-STD-607-A.

2.06 LABELING

A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

PART 3 EXECUTION

3.01 EQUIPMENT AND PATHWAYS

A. Entrance pathways shall comply with Division 26 Section "Raceway and Boxes for Electrical Systems.”
B. Comply with NECA 1.
C. Comply with BICSI TDMM for layout and installation of communications equipment rooms.
D. Cable Runways in Equipment Rooms: Comply with NEMA VE 2 and TIA/EIA-569-A-7.

E. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
F. Cable Supports shall be installed at intervals not exceeding 5' and shall be installed directly to beams, ceiling structure, or walls independent of other trades anchoring/hanging systems; furnish and install all required fasteners and anchoring equipment for cable support system. Install cable supports in accordance with manufacture manufactures fill capacities and per NEC requirements.
G. The communications cabling contractor shall verify bushings have been installed on all conduit ends and conduit sleeves, and provide bushings as required, prior to installing communications cabling to avoid damaging cable sheathing.

3.02 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
B. Comply with ANSI-J-STD-607-A.
C. Refer to Division 27 Section “Basic Requirements for Technology Systems” for additional requirements.

3.03 BACKBOARDS

A. Provide ¾” fire rated plywood installed the full length of wall behind data equipment racks, A/V cabinet, and along the same wall as demarcation; 60 days before grand opening date.

3.04 IDENTIFICATION

A. Identify system components, cabling, and equipment complying with TIA/EIA-606-A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."
B. Label each equipment rack with its technology closet number at top (TC1, TC2, TC3, etc. depending upon its location).
C. See Division 27 Section "Communications Horizontal Cabling" for additional identification requirements.
D. Labels shall be preprinted or computer-printed type.

END OF SECTION

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SECTION 27 12 00

IDENTIFICATION FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. This section covers the identification and labeling for all Division 27 communications systems.

B. Identification and labeling for communications shall conform to ANSI/TIA/EIA 606 standards, labeling requirements specified herein and as indicated on detail drawings.

1.02 SUBMITTALS

A. Included with the shop drawing submittals, the Contractor shall provide a sample of all label types and labeling methods planned for use on the project. The labeling sample submittal shall include the following items:

1. Labels attached to an 8½x11 sheet of paper with a written description of each label and the intended use for each label
2. Provide one sample of custom style faceplates including engraved labeling
3. Indicate the labeling method and labeling scheme intended for identifying both end of cables (on cabling sheathing).

PART 2 PRODUCTS

2.01 NOT USED

PART 3 EXECUTION

3.01 GENERAL

A. Labels shall be machine generated (unless other methods are specifically indicated) and shall be made with the Brady TLS 2200 thermal labeling system or approved equal labeling system. Labels shall be a permanent polyester material clear in color (or color matching/near color of material affixed to label) with label lettering black in color (or of a contrasting color; i.e., white letters on black label when label is placed on black surface).

B. Surfaces shall be cleaned before attaching labels. All labels shall be attached firmly and vertically plumb on equipment, faceplates, patch panels, etc.

C. The Engineer and Owner shall approve the Labeling scheme prior to the installation of any cabling.

D. All labeling of cables, equipment, and components shall be included in as-built documentation, floor plan drawings, and schematic diagrams.

3.02 LABELING OF CABLES

A. All structured cables (horizontal and backbone) shall be labeled at both ends within 3” of cable termination point. Where voice backbone cables extend behind termination blocks, cable labels shall be places at a location on the cable where the labels are visible from the front of the termination blocks.

B. Labels shall have an adhesive backing and shall wrap completely around the circumference of the cable sheathing. Label and lettering sizes shall be of appropriate size for the varying cable sizes.

C. All of the Cat 6 Jacks within the club are within specific Emergency 911 Zones (e.911). These zones are in place so that calls to 911 originate from a general area of the club that will give the first responders more detailed information about the location within the club that the emergency is taking place (or was reported). It will provide the first responders with information like “Life Time, Indoor Pool, and Main Entrance” for example.

D. The cabling within the club has been installed in a pattern that allows for growth or the installation of additional drops in the future without creating a messy cabling or numbering scheme. Each e.911 zone within the club terminates onto a patch panel(s) dedicated to that zone. For each zone, cables are terminated onto 48 port Patch Panels, even if there are less than 48 jacks in the zone. The numbering from panel to panel allows for jacks to be added to a zone at a later date without throwing non-sequential jack numbers into a zone. Because of this, there are gaps in the jack numbers

installed within the club, as the entire jack numbers within a zone have been reserved for that zone.

3.03 LABELING OF EQUIPMENT RACKS AND TERMINATION HARDWARE

A. All communications equipment racks, cabinets, fiber enclosures, and termination hardware shall be clearly labeled at the top, left-hand corner of the equipment.

B. Equipment Racks and Cabinets shall have 3/4” to 1” high lettering and shall be labeled with the telecommunications room number followed by an alphanumeric character in sequence for each rack/cabinet; labeling scheme shall match existing.

C. Fiber Enclosures shall have 3/8” to 1/2” high lettering and shall be labeled with the telecommunications room number followed by an alphanumeric character of the rack/cabinet and the enclosure number; labeling scheme shall match existing. Additionally, each strand of fiber shall be identified with the termination location of the opposite end and the fiber position number on the outside (or inside) front cover and top, left-hand corner of the enclosure under the enclosure label.

D. Patch Panels shall have 3/8” to 1/2” high lettering and shall be labeled with the telecommunications room number followed by an alphanumeric character of the rack/cabinet and the patch panel number; labeling scheme shall match existing utilizing resident unit room numbers.

E. Voice Termination Blocks shall have voice backbone cable pairs labeled starting with V001 starting at the main communications room and continuing sequentially and matching existing labeling scheme.

3.04 LABELING OF FACEPLATES

A. Work Area Outlets shall have 3/16” high lettering with the labeling method as indicated in Specifications Section 271543 and on detail drawings. Voice and data outlets shall be identified utilizing resident unit room number matching existing labeling scheme. The contractor shall terminate all cabling in a sequential method.

END OF SECTION

SECTION 27 12 50
OPERATION, MAINTENANCE, AND WARRANTIES FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. This section describes the general operation, maintenance, and warranty requirements relating to all Division 27 systems.

B. This section will also cover any special training requirements the Contractor is required to provide to the Owner.

1.02 GENERAL COMMUNICATIONS SYSTEMS OPERATION AND MAINTENANCE REQUIREMENTS

A. All Communications Systems shall be demonstrated to be operation to the Owner and Engineer by documented test results and/or actual performance demonstrations of installed components. Systems shall perform at or beyond levels described in this section or other Division 27 sections.

B. Structured Cabling shall perform at or beyond levels required to obtain the specified connectivity hardware manufacturer's applications assurance warranties and as required by Section 27 08 00 (Testing of Communications Systems).

1.03 COMMUNICATION SYSTEM WARRANTIES

A. All Communication Systems shall include a one-year workmanship warranty from the Contractor. The workmanship warranty will start at the Substantial Completion Date which is the date mutually agreed upon between by the Owner, Contract, and Architect/Engineer; A.I.A. form G704 (Certificate of Substantial Completion) will document this date. The Contractor's workmanship warranty shall provide corrective action, at no cost to the Owner and in a timely manner, for instances where products are found to be defective, poor installation practices have been discovered, specified work was found to be incomplete, or communications systems are unable to perform properly on the cabling systems.

B. Extended and Special Manufactures Warranties and/or Service Agreements will be required as described below for the following systems or system components.

1. Category 6 Cabling, Connectivity Hardware, and Patch Cables shall be covered by a warranty offered by the connectivity hardware manufacturer; this warranty shall provide coverage if the cabling system fails to perform under any of the following applications:
    a. 10BaseT, 100BaseT, or 1000BaseT
    b. 155/622 Mbps ATM
    c. Voice-Over-IP (analog or digital)
    d. 100 Mbps TP-TMD
    e. Analog and Digital (Baseband/Broadband) Video
    f. The application assurance warranty shall be structured in a manner that the Contractor providing corrective services will be reimbursed by the warranty provider when the manufacturer's warranty requirements have been met. The Contractor shall register the cabling system with the connectivity hardware manufacturer to obtain the warranty for the Owner and include the approved warranty certificate in the final as-built records. The Owner will be responsible for adhering to the warranty stipulations if they should desire to continue receiving applications assurance warranty coverage.

PART 2 PRODUCTS

2.01 NOT USED (REFER TO OTHER DIVISION 27 SECTIONS)

PART 3 EXECUTION

3.01 GENERAL OPERATION, MAINTENANCE AND WARRANTY DOCUMENTATION REQUIREMENTS

A. System Operation Manuals for all system components shall be provided to the Owner and included with the as-built documentation. 3-ring binders with all documentation hole punched, neatly, organized, and index tabbed shall be provided

B. Manufacture & Extended Warranties for all system components shall be provided to the Owner and included with the as-built documentation. 3-ring binders with all documentation hole- punched, neatly, organized, and index tabbed shall be provided.

3.02 COMMUNICATIONS SYSTEMS TRAINING

A. Structured Cabling System Training shall be reviewed by the Contractor in a final project close-out meeting with the Engineer and Owner's representatives. The training on the structured cabling system shall include, but not limited to, the following items:

1. Review of the distribution and labeling method schemes
2. Review of patch panel and rack layouts
3. Review of as-built drawings and documentation
4. Explanation of test results and data
5. Review of Engineer's Final Project Review Report with discussion of resolutions for any outstanding items
6. Explanation of Quality Assurance Warranties, 1-Year workmanship warranty, and any other extended warranties
7. Discussion of future problem resolution procedures
8. The Contractor shall provide a written outline of the meeting including important contact information (i.e., phone numbers and contact personal for problem resolution).

END OF SECTION

SECTION 27 1300
STRUCTURED CABLING GENERAL REQUIREMENTS

PART 1 GENERAL

1.01 SUMMARY

A. This section covers general installation practices for all Division 27 series communications cabling and equipment products.

B. All work specified under Division 27 series sections shall follow installation practices described herein and all guidelines as established by the following codes and standards:

1. ANSI/EIA/TIA-568-C.0 and C.1 (Commercial Building Telecommunications Cabling Standard – General Requirements)
2. ANSI/EIA/TIA-568-C.2 (Commercial Building Telecommunications Cabling Standard – Balanced Twisted-Pair)
3. ANSI/EIA/TIA-568-C.3 (Optical Fiber Cabling Components Standard)
4. ANSI/NECA/BICSI-568 (Standard for Installing Commercial Building Telecommunications Cabling)
5. NFPA 70 (National Electrical Code)
6. OSHA Regulations
7. All addenda to the codes, standards, and regulations lists above shall be applicable.

1.02 OVERVIEW OF STRUCTURED CABLING WORK

A. The structured cabling work includes all cabling and components required for the voice and data communications systems.

B. Other systems, including CCTV, TV, Audio-Video, Security, Paging, Intercom, or other smart building systems may utilize portions of the structured cabling system. Should other systems need special structured cabling requirements, specific reference will be made in other specification sections and/or on drawings.

PART 2 PRODUCTS

2.01 NOT USED

PART 3 EXECUTION

3.01 GENERAL

A. All cable, equipment, and components shall be installed in accordance with manufacturer’s written instructions, in compliance with NEC, and in accordance with industry standard practices.

B. All equipment shall be installed in a neat, professional manner, always vertically plumb and securely fastened.

C. Equipment and cable colors shall be consistent throughout the entire project unless specifically noted otherwise. In example, if horizontal data UTP cable is specified as blue, then blue cable shall be used throughout the entire project; or, if equipment racks are specified as black, then black racks, black rack mounting screws, and black cable mangers shall be used throughout the entire project.

D. All equipment racks/cabinets, cable tray, cable runways, and metallic sheathing on cables shall be bonded and grounded to the communications grounding system; refer to Section 27 05 10 (Basic Requirements for Communications Systems) for more information.

E. All equipment, cabling, and terminations shall be labeled; refer to Section 27 12 00 (Identification of Communications Systems) for more information.

F. The communications cabling contractor shall provide approved fire-stopping materials in and around any opening created for communications cabling where code or good installation practices suggests or requires fire-stopping materials.

G. All sleeves in smoke rated walls and floor penetration openings shall be fire stopped using either a pillow or fire protection putty per prevailing code requirements upon completion of cable installation; mineral wool is to be placed inside the sleeve. For proper fire stopping the fill ratio (cable to sleeve

volume) will range from a minimum of 12% to a maximum of 40%.

3.02 CABLING INSTALLATION PRACTICES

A. All cabling shall be installed in accordance with manufacturers' written bend radius and pulling tensions. General industry guidelines recommend the following bend radius and pulling tensions:
   1. Tensile loading on a single 4-pair copper UTP cable shall not exceed 25 lbf.
   2. Bend radius of a single 4-pair copper UTP cable shall not exceed 4 times the diameter of the cable.
   3. Bend radius of multi-pair copper UTP and optical fiber cable shall not exceed 10 times the diameter of the cable.
   4. Manufacturers' minimum bend radius specifications shall be observed in all instances. Use of plastic cable ties is not acceptable. Cable bundles shall be neatly dressed with use of Velcro type straps.

B. All conduits and conduit sleeves shall have bushings or grommets shall be installed prior to the installation of communications cables to avoid damage and abrasions to cable sheathing and insulation. If bushings have are installed by the electrical contractor, the communications cabling contract shall furnish and install bushings prior to pulling communications cabling.

C. The maximum station cable drop length for UTP cables shall not exceed 295 feet (90 meters) in order to meet data communications performance specifications. This length is measured from the termination panel in the wiring closet to the outlet and must include any slack required for the installation and termination. The LVC contractor is responsible for installing station cabling in a fashion as to avoid unnecessarily long runs. Any area that cannot be reached within the above constraints should be identified and reported to Life Time Telecommunications Engineer prior to installation. Life Time Telecommunications Engineer should approve changes to the plan.

D. Splices are not permitted in any voice or data cable unless other specified or show on drawings. All cables shall be installed splice-free from telecommunications rooms (MDF, IDF) to the work out area (WOA).

E. Avoid placing copper cables near sources of extreme heat (i.e., boilers, radiators, heat coils).

F. Maintaining cable twists for all UTP cables. For terminations cable sheathing shall be stripping back no more than ½" back from termination point for all Category 5e and Category 6 cables.

G. All cables shall be supported by cable tray, cable runway, Arlington Strap or J-hooks. When large quantities of cables leave trays or runways, cables shall be supported by drop-outs or cable support hardware manufactured specifically for the purpose of supporting cables. J-hooks shall be installed a minimum of every 5 feet and cabling shall maintain minimal deflection and strain (less than 12" deflection). Cables shall not be supported from ceiling grid wires. Cables shall not run above iron joists.

H. All cables shall be separated and bundled into like groups by cable sheathing colors.

I. Service loops shall be provided at both ends of installed horizontal and backbone cabling. A 24" service loop shall be installed in the ceil space near workstation outlets at the last support (e.g. Arlington Strap) before the cables enter a fishable wall, conduit, surface raceway, or box; excessive cable shall not be coiled in outlet boxes. A 10' service loop shall be provided in communication rooms and shall be installed to allow for future equipment rack/cabinet relocations without the need to re-terminate patch panels; the 10' service loop shall be neatly bundled and secured in ceiling space with large D-rings or place in cable trays. Manufacturers' minimum bend radius specifications shall be observed in all instances. Use of plastic cable ties is not acceptable. Cable bundles shall be neatly dressed with use of Velcro type straps.

J. Any cabling installing in equipment rooms shall be neatly placed in cabling trays, cabling runways, or horizontal and vertical rack/cabinet cable managers. When tray, runways, or cable managers are not specified, cable shall be neatly installed with Ladder Racking or D-rings. Cables shall always be installed vertically/horizontally or at right angles to structure.

K. Utilize Velcro straps to secure permanently installed horizontal and backbone cabling; any cable ties installed in plenum ceiling spaces shall be rated for use in plenum spaces. Cable ties shall never be secured too tight whereby potentially changing the cable geometry. Do not use vinyl tie straps.
L. All Category 3, Category 5e and Category 6 cables shall be terminated TIA/EIA-568B.
M. Free-air installation shall be installed as follows:
    1. Cable shall be run at right angles and be kept clear of other trades' work.
N. Cable shall never be laid directly on the ceiling gird.
O. All cable shall be free of tension at both ends. In cases where the cable must bear some stress, Kellum grips may be used to spread the strain over a longer length of cable.
P. Cables shall not be attached to existing cabling, plumbing, or steam piping, ductwork, ceiling supports, or electrical or communications conduit.
Q. Cable sheaths shall be protected from damage from sharp edges. Where a cable passes over a sharp edge, a bushing or grommet shall be used to protect the cable.

END OF SECTION

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SECTION 27 1350
STRUCTURED CABLING FOR VOICE AND DATA

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Category 6 Cable, Jacks, Faceplates, Surface Mount Boxes (SMB), and Patch Panels.

1.02 RELATED REQUIREMENTS

A. Section 078413 – Firestopping.
B. Section 260537 - Boxes.

1.03 REFERENCE STANDARDS

A. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
B. TIA/EIA-568-C.1 - Commercial Building Telecommunications Cabling Standard - Part 1: General Requirements; Rev C, 2012; Addenda 1-7.
C. TIA-569 - Commercial Building Standard for Telecommunications Pathways and Spaces; 2012.
D. TIA/EIA-606 - Administration Standard for the Telecommunications Infrastructure; Rev B, 2012.

1.04 SUBMITTALS

A. See Section 01 30 00 for Administrative Requirements and submittal procedures.
B. Product Data: Manufacturer's data sheets on each product to be used, including:
    1. Storage and handling requirements and recommendations.
    2. Installation methods.
C. Installer Qualifications.
D. Field Test Reports.
E. Project Record Documents:
    1. Record actual locations of outlet boxes and distribution frames.
    2. Show as-installed color coding, pair assignment, polarization, and cross-connect layout.
    3. Identify distribution frames and equipment rooms by room number on contract drawings.
F. Operation and Maintenance Data: List of all components with part numbers, sources of supply, and operation and maintenance instructions; include copy of project record documents.

1.05 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements listed below.
B. Installer Qualifications: A company having at least 5 years experience in the installation and testing of the type of system specified, and:
    1. Contractor employs a BICSI Registered Communications Distribution Designer (RCDD) and BICSI Certified Technicians.
    2. Supervisors and installers factory certified by manufacturers of products to be installed.
C. The contractor shall become familiar with installation guides and any other miscellaneous installation documentation prior to the commencement of the work.
D. Any discrepancies between the design specifications, drawings, field conditions, and manufacturer's recommendations shall be brought to the attention of Life Time immediately in writing.

1.06 DELIVERY, STORAGE, AND HANDLING

A. The cabling contractor shall be responsible for the procurement, storage and security of all materials either purchased by or supplied to the contractor for installation throughout the project.
B. All cables and components shall be protected from damage through the construction project.

PART 2 PRODUCTS

2.01 SUMMARY

A. Unless noted otherwise, all products shall be owner preferred product solutions listed in sections 2.02 through 2.13 or be approved equal.

2.02 CATEGORY 6 CABLES

A. Cable shall consist of 4-pair plenum rated balanced Unshielded Twisted Pairs U/UTP. 100 OHM, 22 AWG to 24 AWG, insulated solid-copper conductors.
B. The cable shall be high performance capable of supporting bandwidths more than 10/100/1000 MBPS for lengths up to 100 Meters (328 Ft).
C. Cable shall be white.
D. Approved products:
    1. Panduit Part #: PUP6C04WH-U
    2. CommScope Part #: 2071E-UTG ETL

2.03 JACKS

A. Cat6 U/UTP jack, white in color.
B. Approved products:
    1. Panduit Part #: CJ688TGWH
    2. CommScope Part #: MGS400 White

2.04 FACEPLATES

A. The color of the faceplates shall be coordinated with finish conditions listed in Division 26 27 26 Wiring Devices.
B. All faceplates shall be covered and protected against dust and paint during construction.
C. 1-Port Faceplate:
    1. Flush mounted faceplate for Cat 6 jacks.
    2. Approved products:
        a. Panduit Part #: CFPL1WHY
        b. CommScope Part #: M10L-262
D. 4-Port Faceplate:
    1. Flush mounted faceplate with labels.
    2. Approved products:
        a. Panduit Part #: CFPL4WHY
        b. CommScope Part #: M14L-262

2.05 SURFACE MOUNT BOX (SMB)

A. SMB port capacity should match the cable quantity.
B. Color of SMB shall match the color of the 8P-8C RJ45 jack.

2.06 CATEGORY 6 PHONE PLATE

A. Wall phone plate:
    1. Stainless steel.
    2. 8P-8C RJ45 jack insert.

2.07 PATCH PANELS

A. 24-Port Cat 6 Patch Panel:
    1. Patch panel shall be black.
    2. Patch panel shall be flat.
    3. Patch panel shall be preloaded.
    4. Patch panel shall be Panduit, CommScope or approved equal.
B. 48-Port Cat 6 Patch Panel:
    1. Patch panel shall be black.
    2. Patch panel shall be flat.
    3. Patch panel shall be preloaded.
    4. Patch panel shall be Panduit, CommScope or approved equal.

2.08 PATCH CORDS

A. All patch cables shall be furnished by the LVC Vendor and installed by Life Time LVC Engineer.

B. Items patched in to the switches should use an appropriately colored patch cable for easy identification and line tracing. Both the color of the patch cable as well as the switch port should be determined by the type of device being patched in.
C. Quantities of patch cables for data and voice shall be provided by the owner. Quantities of patch cables for the audio and visual systems shall be provided by the audio/visual contractor.
D. All patch cables shall be Cat 6. (28 AWG high-density patch cable to optimize the space in equipment racks cable management) and the modular plug be tangle free with strain relief boot.
E. Items patched in should be routed and protected properly utilizing the provided cable management hardware on the Racks. Items in the IDF Rack should also be bundled utilizing the Velcro Cable Wraps to protect them from being snagged or ripped out.
F. Copper patch cables shall be the following lengths and colors:
    1. Manufacturers:
        a. Panduit Part #: UTP28SP6
        b. CommScope Part #: UNC6 series
    2. Fitness Floor TV's and Fitness Cardio Equipment
        a. Color: Black.
        b. Length: 5 ft.
    3. Club Network Devices at MDF/IDF Equipment Rooms
        a. Color: Blue.
        b. Length: 7 ft.
    4. Servers / WAN Links at Building Demarcation/MDF/IDF Equipment Rooms
        a. Color: Red.
        b. Length: 7 ft.
        c. Length: 14 ft.
    5. Analog Dial Tone at MDF/IDF Equipment Rooms
        a. Color: White.
        b. Length: 7 ft.
        c. Length: 14 ft.
    6. Work Area Outlet / Station Cords
        a. Color: Black.
        b. Length: 7 ft.
        c. Length: 14 ft.
    7. Video Surveillance Cameras at MDF/IDF Equipment Rooms
        a. Color: Black.
        b. Length: 7 ft.

2.09 WORK AREA OUTLET STATION CORDS

A. Station cords shall be similar to patch cords.
B. All station cords shall be Cat 6 and be black in color.
C. All computer and phone station cords shall be 7' long, furnished and installed by owner.

2.10 WIRELESS ACCESS POINTS (AP)

A. Cabling for wireless access points (WAP) is installed by Low-Voltage Cabling Contractor.
B. WAP devices are furnished by Life Time Technology and installed by the Low-Voltage Cabling Contractor per the direction of Life Time Technology.

2.11 FIBER PATCH CABLES

A. Fiber patch cables shall be provided by LVC cabling contractor.
B. 10Gig 50/125um aqua, LazrSPEED.
C. Fiber optic connectors shall be LC to LC unless otherwise noted.Lengths and quantities of fiber patch cable should be confirmed with Life Time Technology prior to ordering.

2.12 EMERGENCY TELEPHONES

A. Emergency phone locations:
   1. Emergency Phones listed are required by owner and no deviation from these make and models will be accepted.
   2. Contractor shall provide and commission emergency phones. The following shall be provided for each location (as applicable):
      a. Men's & Women's Locker Room Wet Spa, Indoor Pool, and Outdoor Pool Locations: Allen-Tel #GB92V14.
      b. Parking Ramps, Pickleball and/or Tennis Court locations: Viking Model E1600-ABLT2EWP.

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

A. Comply with latest editions and addenda of TIA/EIA-568, TIA/EIA-569, ANSI/J-STD-607, NFPA 70, and SYSTEM DESIGN as specified in PART 2.

3.02 PATHWAYS

A. To reduce or eliminate EMI, the following minimum separation distances from power lines, fluorescent lights and other RF sources such as motors and generators shall be adhered to:
   1. 39 inches from motors, generators, frequency converters, transformers, x-ray equipment, and uninterruptible power systems.
   2. 12 inches from power conduits and cables and panel boards of less than 5 kVA.
   3. 18 inches from fluorescent and high frequency lighting fixtures.
   4. 6 inches from flues, hot water pipes, and steam pipes.
   5. 39 inches from power lines of greater than 5 kVA.

B. Conduit:
   1. Do not install more than 2 (two) 90 degree bends in a single horizontal cable run.
   2. Leave pull cords in place where cables are not initially installed.
   3. Conceal conduit under floor slabs and within finished walls, ceilings, and floors except where specifically indicated to be exposed.
      a. Conduit may remain exposed to view in mechanical rooms, electrical rooms, and telecommunications rooms.
      b. Treat conduit in crawl spaces and under floor slabs as if exposed to view.
      c. Where exposed to view, install parallel with or at right angles to ceilings, walls, and structural members.
      d. Under floor slabs, locate conduit at 12 inches, minimum, below vapor retarder; seal penetrations of vapor retarder around conduit.

C. Outlet Boxes:
   1. Coordinate locations of outlet boxes provided under Section 260537 as required for installation of telecommunications outlets provided under this section.
      a. Locate outlet boxes so that wall plate does not span different building finishes.

D. Grounding and Bonding: Perform in accordance with ANSI/J-STD-607 and NFPA 70.

E. Firestopping: Seal openings around pathway penetrations through fire-rated walls, partitions, floors, and ceilings in accordance with Section 078413.

3.03 INSTALLATION OF EQUIPMENT AND CABLING

A. Cabling:
   1. Do not bend cable at radius less than manufacturer's recommended bend radius; for unshielded twisted pair use bend radius of not less than 4 times cable diameter.
   2. Do not over-cinch or crush cables.
   3. Do not exceed manufacturer's recommended cable pull tension.
   4. When installing in conduit, use only lubricants approved by cable manufacturer and do not chafe or damage outer jacket.

B. Field-Installed Labels: Comply with TIA/EIA-606 using encoded identifiers.
   1. Cables: Install color coded labels on both ends.
   2. Outlets: Label each jack on its face plate as to its type and function, with a unique numerical identifier.

3.04 FIELD QUALITY CONTROL

A. Comply with inspection and testing requirements of specified installation standards.
B. Visual Inspection:
   1. Inspect cable jackets for certification markings.
   2. Inspect cable terminations for color coded labels of proper type.
   3. Inspect outlet plates and patch panels for complete labels.
C. Final Testing: After all work is complete, including installation of telecommunications outlets, and telephone dial tone service is active; test each voice jack for dial tone.

END OF SECTION

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SECTION 27 1500
COMMUNICATIONS BACKBONE CABLING

PART 1 GENERAL

1.01 SUMMARY

A. This section covers copper horizontal cabling utilized by all Division 27 systems and possibly other intelligent building systems specified by other Divisions.

B. Quantities and pair count for all copper backbone cabling shall be provided as required to complete cabling system as shown on the drawing schematic diagrams.

C. Unless noted otherwise, all product shall be equivalent of the owner preferred solutions listed in PART 2.

PART 2 PRODUCTS

2.01 COPPER BACKBONE CABLING

A. Voice Backbone Cable shall comply with the following requirements:
   1. TIA/EIA Category 3 compliant
   2. 24 AWG solid bare copper conductor, unshielded twisted pair
   3. Industry standard conductor insulation color coding (blue, orange, green, brown, slate); bandmarked PVC insulation
   4. Plenum rated, UL Listed CMP marking on cable
   5. Product identifications and cable distance markings at regular intervals on cable

B. Communications Copper Cable Splicing and Terminations:
   1. Copper backbone shall extend from MDF to IDF(s) and detached Bistro, where applicable.
      a. Category 3 U/UTP plenum rated cable. White cable jacket, 25-pair count.
      b. Approved products:
         1) CommScope Part #: 2010B WH 25/24 R1000
         2) Or approved equal.
   2. Emergency Phone's, POTS Lines Extension, Internal Analog Devices
      a. LVC installer to extend dedicated POTS line to each emergency phone and program emergency phone to ring-down to specific number. Each phone comes with program instructions.
      b. Install Life Time Fitness assigned POTS to fire panel and elevator.
      c. Extend internal analog phone lines to courtesy phones in locker rooms, on the work out floor, analog lines to credit card machines in Life Cafe and Life Spa, and fax machines.

2.02 OPTICAL FIBER BACKBONE CABLING

A. Indoor 50/125µm Multi-Mode Optical Fiber Cable shall comply with the following requirements:
   1. Maximum attenuation of 3.5dB/km @ 850nm and 1.5dB/km @ 1300nm
   2. Plenum rated, UL Listed type marking on cable
   3. Product identifications and cable distance markings at regular intervals on cable
   4. Aramid yarn central strength members
   5. Plenum rated armored cable, aqua in color.
   6. 12-Strand LazrSPEED, 50um OM3, 300m.
   7. CommScope Part #: P-012-DZ-5L-FSUAQ or Panduit equal.

B. Exterior backbone fiber optic cable shall be indoor/outdoor single unit plenum distribution type installed within conduit system. At building entrances, provide termination of all conductive portions of the assembly to ground. Install fiber within plenum rated innerduct or plenum rated armored sheath to fiber interconnection unit for physical protection.

2.03 OPTICAL FIBER CABLE TERMINATING CONNECTORS

A. Provide rack mounted fiber enclosures capable of terminations and splices noted on drawings. Equip with LC connectors and cover plate. Units shall provide top or bottom cable entry, fiber termination,

cross connection, interconnection, routing, fiber identification labels, fiber storage and radius organizers.

B. Optical Fiber Connectors shall be LC-type and shall comply with the following requirements:
   1. Comply with ANSI/TIA/EIA 568-B.3
   2. Ceramic ferrules utilizing adhesive for connection to ferrule
   3. Designed for multimode 50/125, 62.5/125µm and single mode fiber
   4. Typical insertion loss of 0.2dB
   5. Coordinate with owner electronics and provide duplex LC connectors where possible.

PART 3 EXECUTION

3.01 GENERAL

A. All backbone cabling shall be labeled on cable sheathing and at termimal points.

B. Wiring in Wire Closets and Cabinets: Install conductors parallel to and at right angles to walls. Bundle, lace, and train the conductors to terminal points and terminate using manufacturer's installation procedures. Connect conductors that are terminated, spliced, or interrupted to terminal blocks.

C. Fire Stopping: Provide fire stopping for all conduit sleeves shown on the plans and as added as required at all fire rated walls. Firewalls are indicated on the architectural drawings and are available for review at the Construction Manager' s office

D. Install cable without damaging conductors or jacket. Do not bend cable to a smaller radius than minimum recommended by manufacturer. Do not exceed manufacturers recommended pulling tensions.

3.02 COPPER BACKBONE CABLING INSTALLATION PRACTICES

A. All pairs of copper backbone cables shall be terminated at both ends.

3.03 OPTICAL FIBER BACKBONE CABLING INSTALLATION PRACTICES

A. The same manufacturer’s product shall be utilized throughout the entire project for all optical fiber backbone cabling.

B. All strands of optical fiber backbone cables shall be terminated at both ends in enclosures.

C. Optical fiber backbone cables shall be installed in cable runways and cable tray systems in such a manner to avoid crushing or cable deformation by other cables. Where optical fiber backbone cables runway/tray support systems, optical fiber backbone cables shall be installed in inter-duct and supported at regular intervals.

D. Splicing of optical fiber backbone cables is only permitted in communication room enclosures for manufacture approved pigtail connectors, at splice enclosures identified on the drawings, or for other special situations with prior approval from the Engineer.

E. A maximum connector insertion loss of 0.75dB is permitted by industry standards; however, typical insertion losses of 0.2dB shall be observed in test results. Contractor may be required to re-terminate connectors if losses are higher than 0.3dB and the to fiber segment loss budgets are excessive.

END OF SECTION

SECTION 27 1600
TESTING OF COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. This section covers contractor testing, and test result documentation for all Division 27 communications systems.

B. All communications systems shall be tested and documented by the contractor installing each system as specified herein.

C. The Engineer and/or Owner may test up to 5% of the cable runs for any communication cabling system prior to substation completion of the project.

1.02 OVERVIEW OF COMMUNICATION SYSTEMS TESTING REQUIREMENTS

A. Structured Cabling System testing shall be completed for all segments of the structured cabling systems including Category 6 horizontal cabling, copper backbone cabling, and optical fiber backbone cabling. All cables shall be tested and documented as specified herein.

PART 2 PRODUCTS

2.01 NOT USED

PART 3 EXECUTION

3.01 GENERAL

A. The Contractor shall notify the Engineer a minimum of one week prior to any testing and shall provide a testing schedule prior to the testing of cabling and equipment. Owner's representatives and the Engineer may be in attendance to witness the test procedures. The Contractor shall re-schedule testing as necessary to accommodate the schedules of the Owner/Engineer for any testing the Owner/Engineer may want to witness.

B. All cable runs shall be tested. Any segment with failing or receiving marginal test results shall be evaluated and receive corrective action. Cable runs continuing to fail test results should be evaluated with the Engineer and shall be replaced when necessary to obtain passing test results.

C. All cable runs must receive passing test results prior to final acceptance of the project.

D. All test results shall be documented and included with contractor's final as-built documentation and will be review by the Engineer prior to final acceptance and closeout of the project.

E. The test equipment manufacturer shall calibrate all test equipment at regular intervals as recommended by the manufacturer. Calibration reports shall be provided to the Engineer upon request.

F. Technicians who have completed an appropriate training course for the use of specified test equipment shall conduct all testing.

3.02 CATEGORY 6 HORIZONTAL CABLE TESTING

A. All Category 5e & 6 horizontal cable runs shall be tested with a Level III tester capable of testing 4-pair UTP cable frequencies from 0.1-250 MHz. The Contractor shall use one of the following testers: Agilent Wirescope 350, Fluke DSP-4000, Ideal LanTek 7, or more current/advanced model from these manufactures.

B. Category 6 cabling shall include the following tests:
   1. Wire Map
   2. Length
      a. Record all cable lengths.
      b. Any cable runs longer than 295 feet shall be brought to the attention of Life Time Technology in writing.
   3. Attenuation (insertion loss)
   4. NEXT (near end cross talk—to be performed on all Category 6 cables BI-directionally)
   5. Power Sum NEXT

6. Pair to pair ELFEXT (equal level far end cross-talk)
7. Power Sum ELFEXT
8. Return Loss
9. Propagation Delay
10. Delay Skew
11. Permanent Link testing shall be performed and shall conform to the following test result parameters defined by ANSI/EIA/TIA 568-C.2-1for Category 5e or 6 as applicable.
12. In addition to 100% of the cables passing all Permanent Link test parameters, the contractor is required to provide a manufacturer's warranty covering the Channel Link (including patch cords/station cords). Refer to Section 27 01 00 for more information on manufacturer's warranty requirements.
13. Test results (in summary format) shall be printed and bound in a 3-ring binder. Provide two copies of the printed test results with the as-built documentation submittal. In addition to the printed test results, the Contract shall provide the detailed electronic test results (on compact disk) and a copy of the test manufacturer's software to view the test results with the as-built documentation submittal. The test equipment manufacturer's software can be provided on CD or can be instructions on how to download the software (free of charge).

3.03 COPPER BACKBONE CABLE TESTING

A. Multi-pair UTP backbone cables shall be tested for the following parameters:
   1. Wire-map (corrector conductor position on 110 blocks)
   2. Continuity
   3. Shorts
   4. Length
   5. All pairs shall be free of shorts, shall be terminated in the correct position, and shall have continuity. Any discrepancies shall be corrected.
   6. Lengths of all copper backbone cables shall be recorded on as-build documentation.

3.04 OPTICAL FIBER CABLING TESTING

A. All strands of all optical fiber cables shall be field-tested (unless specifically noted on drawings as un-terminated strands for future use). Field test equipment and testing methods for multimode optical fiber cable shall meet the requirements of ANSI/EIA/TIA-526-14A; single-mode field test equipment and methods shall meet the requirements of ANSI/EIA/TIA-526-1. Optical fiber cabling testing shall adhere to the following criteria:
   1. Building backbone fiber cabling shall be tested with a power loss meter for insertion loss (Link Attenuation) in both directions and at both operating wavelengths.
   2. Test equipment shall measure the length and automatically calculate the link loss based on ANSI/EIA/TIA-568-C.1 standard loss values; all links shall receive a PASS value.
   3. Test results, including distances and insertion loss readings shall be printed and bound in a 3-ring binder. Provide two copies of the printed test results with the as-built documentation submittal.

END OF SECTION

SECTION 27 2000
AMBIENT SOUND DISTRIBUTION AND MASKING SYSTEM

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and General provisions of Contract including General and Supplementary Conditions and Division 1, specification sections, apply to the work of this section.

1.02 DESCRIPTION OF WORK

A. Provide equipment and hardware to provide a complete integrated audio distribution system and sound masking system. Furnish all specified materials, products, installation labor, programming, and testing work required for a complete and fully functioning system. Equipment notated on BOM as "OFE" is owner furnished equipment by Life Time. Work includes:
   1. This section pertains to speakers, unless specified otherwise.
   2. The work provided under this specification and the associated drawings, applies to the Facility including indoor and outdoor areas as designated in the drawings.
   3. The audio system will be composed of equipment provided under this Contract. All equipment shall be installed by the A/V Contractor.

B. A conduit / raceway system required to support this equipment will be provided by others.

1.03 DEFINITIONS

A. AV or A/V = Audio Video
B. AVC = Audio Video Contractor
C. BOM = Bill of Material
D. CAD = Computer aided design
E. DMX = Digital Multiplex
F. DSP = Digital Signal Processor (for Audio)
G. EC = Electrical Contractor
H. GC = General Contractor
I. GF = Group Fitness Studio
J. IDF = Intermediate Distribution Frame (Secondary IT Closet)
K. IT = Information Technology (For this document its referred to as a department)
L. LAN = Local Area Network
M. LTF Standards = Life Time Standards
N. LVC = Low Voltage Contractor
O. MDF = Main Distribution Frame (Main IT closet)
P. Misc. = Miscellaneous
Q. NEC = National Electric Code
R. OFE = Owner Furnished Equipment (By Life Time)
S. POE = Power Over Ethernet
T. QLAN = Q-Sys local area network
U. Q-SYS = Manufacturer "Q-Sys"
V. SPL = Sound Pressure Level
W. SOW = Scope of Work
X. UL = Underwriters Laboratories (Safety Standards
Y. XLR = External Line Return (Style of Audio connector)

1.04 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements listed below.

B. Installer Qualifications, Certifications, and General Knowledge:
   1. CTS and Dante Certification by representative working directly on this project.

2. Dante Certification.
3. Q-Sys Designer Level 2 Completion.
4. Experience with Bluebeam Revu, AutoCAD, Microsoft Windows 10, and Microsoft Office Suite.
5. Network switch configuration experience including, but not limited to, IP addressing, QoS, VLAN, and DHCP.

C. Manufacturers
1. The system shall be the product of the specified manufacturers, installed by an agency experienced in such work. The installation and connections of all equipment and tests of the operation of the system be made by a representative of the manufacturer or aforementioned installing agency.
2. Contractor / integrator providing this system must be manufacturer approved to furnish, install, maintain, and warranty the system equipment specified.

D. Installation
1. Installation of required raceways, conduits, and power receptacles shall be by the electrical contractor. The installation of communication outlets, wallplates, devices, and connections of all parts of the audio system shall be done by the A/V Contractor.

E. Programming
1. The Contractor shall employ the services of an experienced system programming specialist for the Digital Signal Processor/Control system provided under this specification and an experienced programmer for configuring and programming the audio DSP processing equipment.

F. NEC Compliance
1. Comply with NEC as applicable to construction and installation of system components and wiring.

G. UL Compliance
1. Where required, provide system equipment which is UL listed and labeled.

H. Licensing
1. Contractor shall comply with local licensing, including state and city laws/regulations.

1.05 SUBMITTALS

A. Licensing details.

B. Product Data
1. Submit manufacturers' data on all equipment, including:
a. Detailed equipment list indicating the manufacturer, model number, and quantity for each equipment item being provided or existing item being re-installed.
b. Manufacturer's product data sheets for each new equipment item
c. Dimensions, rough-in drawings, installation instructions, and operation and maintenance, suitable for inclusion in maintenance manual.

C. Shop Drawings
1. Shop drawings provided by Life Time. Adjustments required must be sent to Life Time AV representative for review and approval. Submit shop drawing data, including:
a. Detailed wiring diagrams of the system. Diagrams shall show connection to each unit of system. Single-line block diagrams are not sufficient.
b. Detail drawings of all custom fabricated panels, connection wallplates and associated components being supplied.
c. Equipment rack elevation / layout diagrams (front face)
d. Audio DSP programming: Provide for review, a proposed configuration layout indicating all DSP processing functions and internal connectivity for the DSP processor.

D. Speaker 70V System Tap Values
1. Prior to installation provide a speaker tap value list for approval by Life Time AV representative.

E. Inputs and Outputs on DSP/Amplifiers must be submitted to Life Time in Excel format.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Prior to acceptance, OFE shall be inspected for damage. If damage on boxes, pallets, or equipment is visible, the shipments shall be rejected and sent back to logistics company. Communicate damage to Life Time AV representative.

B. Store products in manufacturer's packaging. Keep dry and protect from damage until ready for installation.

C. Equipment must be kept locked up at all times in either an on-site storage container provided by AV Installation contractor or within the building in a designated secure location.

D. Contractor shall not install any product in construction areas where the product is subject to damage from water, dust, and construction debris.

E. Contractor is responsible for their own tools and AV components that they are installing. Keep them secure at all times.

PART 2 PRODUCTS

2.01 GENERAL

A. Provide materials in quantities listed in Life Time BOM for a complete and operational system as indicated herein and in the drawings.

B. Coordinate with system block diagrams for verification of specific quantity of equipment items required in each system.

2.02 OWNER PROVIDED EQUIPMENT/MATERIAL (OFE)

A. Reference BOM for purchasing equipment. Do not provide items indicated as OFE.

2.03 CONFLICTS WITH BOM

A. Present conflicts, errors, or omissions to Life Time AV representative for review and approval prior to purchasing.

2.04 SUBSTITUTIONS ON BOM

A. All substitutions outside of owner provided BOM must be presented and approved by Life Time AV representative.

2.05 MISCELLANEOUS MATERIALS

A. Provide list of construction required equipment for installations not called out specifically on BOM.

PART 3 EXECUTION

3.01 GENERAL

A. Wiring, except in equipment cabinets and where raceway or cable tray is provided, shall be routed open above suspended ceilings and in accessible walls and shall be in accordance with manufacturer's directions. All wiring in ceiling spaces shall be plenum rated. In accessible ceiling spaces, wiring shall be supported from ceiling structure at regular intervals of at least 48 inches. Cabling shall not be attached to or supported by ceiling tile support wires.

B. Final wiring connections shall be made and the entire system shall be tested and certified as working properly by an authorized representative of the Contractor. Written verification of test results shall be furnished to the Owner, Architect, and Engineer.

C. Identify and tag all cables with permanent type markers to denote location served.

D. All rack and in-cabinet wiring and cabling shall be neatly routed in plastic wiring duct or secured with tie wraps and routed along rack sides. All splices and connections shall be by plug, solder, or captive screw terminal strips, etc. Splices shall not hang in rack or cabinets.

3.02 INSTALLATION

A. Systems installation, cabling and rack building procedures shall fall in strict accordance with industry standards and manufacturer recommendations for safety and operation compliance.

B. Componentry installed during construction shall be either installed after finish carpentry and drywall sanding/construction is complete or covered in a method conducive to provide a dust free

environment for the installed items if the possibility of damage could occur to the item prior to first use by the client.

C. Final installation measures by the AVC shall include cleaning components to eliminate fingerprints, dust, or debris during the installation phase. Additional cleaning required by Life Time prior to first use by client will incur a cleaning fee payable by the AVC.
D. Install all equipment, components, accessories, terminal blocks, connectors and hardware necessary to provide a complete and operational system. Connector types and quantities shown in the drawings are representative and the Contractor shall be responsible to supply any additionally required connectors and wiring. Connectors shall be provided and installed as recommended by the manufacturer of the terminating equipment. All other wiring connections to connectors mounted on input plates and floor boxes shall be soldered connections or crimp (video) connections.
E. All interconnects must be tied neatly with Velcro ties every 12”.
F. Zip ties are not allowed.
G. Cable minimum bend radius after installation shall be no less than 10 times the cable diameter.
H. Speaker installation by type:
    1. In-ceiling /flush mount style speakers
        a. In-ceiling speakers shall be mounted in ceiling tiles or gypsum wallboard ceilings according to the manufacturer’s direct specifications.
        b. Unless otherwise stated in writing by the owner, the specifications and mounting techniques will be followed verbatim and applied to site installation.
        c. A hole shall be cut using the supplied cut-out template. The speakers will have their terminations made by the installer at the time of concealment in the tile or gypsum.
        d. Speaker terminations shall be precisely cut and managed in the connector or crimp methods.
        e. A service loop 10” in circumference shall be utilized and relieve strain to speaker connections. Exposure of bare copper conductors is a hazard to the electronics systems and shall not be permitted. In outdoor applications, exposure to the elements leads to corrosion and damage to the integrity of the cable and shall not be permitted.
        f. Drop ceiling tiles shall have tile bridge supports in place for all in-ceiling speakers. Tile bridges will be installed per the manufacturer’s specification.
        g. The ceiling tile shall not solely support the weight of the speaker.
        h. Ceiling grid support pencil rod shall be utilized to support the added weight of the speaker against the ceiling grid. Support pencil rod shall be shot directly into the deck/ceiling or fastened to structural members with beam clamps or a combination of them and d-rings.
        i. At no point shall the speaker support pencil rod be secured to existing pencil rod that is used for existing ceiling grid support.
        j. The roto-lock clamps will be securely tightened. Moderate resistance felt while securing the clamps will ensure that the speaker has been clamped successfully. Over tightening can damage the clamp and the speaker and make grill installation difficult or unsuccessful.
        k. Speaker, clamp, or grill damage shall be the responsibility of the installer and shall be reported to a Life Time AV representative and replaced immediately by the AVC.
    2. Surface mount style speakers
        a. Surface mount speakers shall be mounted to brick, wood, concrete, or gypsum wall types according to the manufacturer’s direct specifications.
        b. Unless otherwise stated in writing by the owner, the specifications and mounting techniques will be followed verbatim and applied to site installation.
        c. Where a cabling backbox has been supplied, the speaker shall be mounted directly below the backbox as to conceal the opening with the body of the speaker. The box shall not be covered by the mount in entirety as to retain the ability to access the opening without the

need to remove the speaker in times of serviceability or cable replacement.

d. The yoke mount or similar shall be fastened to the surface utilizing the appropriate weight distributing fastener for the application.
e. A proportional weight rating relationship of 5:1 shall be applied when choosing the appropriate fastener and the wall surface in which the device is to be mounted.
f. Plywood backing shall be called out by AVC and installed by GC as required prior to AVC site installation.
g. The yoke mount shall be secured to a wall stud where available.
h. Speaker terminations shall be precisely cut and managed in the connector or crimp methods.
i. A service loop 10” in circumference shall be utilized and relieve strain to speaker connections.
j. Exposure of bare copper conductors is a hazard to the electronics systems and shall not be permitted. In outdoor applications, exposure to the elements leads to corrosion and damage to the integrity of the cable and shall not be permitted.
k. Interior/exterior speaker cabling for surface-mounted speakers shall require a drip/service loop in before securing the cable to the connector or binding post(s) of the speaker/device.
l. Aircraft safety cable shall be applied to all devices based on geographic location and seismic requirements.
m. Consult the local building codes per the authority having jurisdiction for exact safety mounting requirements.

3. Pendant speakers
   a. Pendant speakers shall be mounted (anchored) directly to the corrugated deck/ceiling via dual aircraft cable suspension and a stress relief cable loop.
   b. Unless otherwise stated in writing by the owner, the specifications and mounting techniques will be followed verbatim and applied to site installation.
   c. Fasteners/anchors shall be of the approved type in the fastener/anchor’s specifications section below.
   d. Only approved devices will be permitted. If the situation calls for alternate mounting methods. A Life Time AV representative and AV Engineer will be notified prior to installation.
   e. Installation by contractor will only occur if the alternate fastening/anchoring device or method is approved by a life-time project manager.
   f. Interior/exterior speaker cabling for surface-mounted speakers shall require a drip/service loop in before securing the cable to the connector or binding post(s) of the speaker/device.
   g. A service loop 10” in circumference shall be utilized and relieve strain to speaker connections.
   h. Plenum rated zip ties shall be used to bundle the cable above the speaker. Exposed, jacketed speaker cabling between the pendant speaker and ceiling-mounted junction box shall be strapped to the aircraft safety cable, with white plenum rated wire retention straps/ties closest to the ceiling-mounted junction box.
4. Outdoor landscape speakers and subwoofers
   a. Outdoor landscape speakers must be installed flush to final landscape mulch, rock, or other landscape material. Installation shall be level and symmetrical.
   b. Speakers must be installed with supplied burial security feet
   c. Provide direct burial speaker cabling and install from speaker to nearest junction box. All wiring must be hidden from view to the nearby junction box. Drill small hole on side or underside of junction box, supply and install with silicone to fill hole.
   d. All screws/boxes/anchors must be secured to speaker/junction boxes.

5. Subwoofers
    a. Subwoofers shall be mounted according to the manufacturer's direct specifications. Unless otherwise stated in writing, the specifications and mounting techniques will be followed verbatim and applied to site installation.
    b. Ceiling mounted subwoofers
        1) Subwoofer installation locations shall vary by the individual site build.
        2) Anchoring subwoofers must be sufficient enough to hold 4 times the weight of the subwoofer/combo.
        3) Anchoring must be done with two (2) primary anchor cables/chains and one (1) backup safety support anchor.
        4) Anchoring into concrete ceiling use Hilti Kwik Bolt concrete anchors. Length will vary depending on thickness of concrete.
        5) Bar joist mounting shall consist of heavy duty uni-strut structure designed to withhold four (4) times the weight of the subwoofer and mount.
    c. Floor mounted subwoofers shall be placed on the floor in the approved location. All wire and cabling paths to and from the subwoofer device shall be concealed and dressed in braided cable wrap sized appropriately for the quantity of cables it will conceal.
6. Speaker taps
    a. All speakers shall be tapped to wattage that does not exceed 80% of total wattage per amp channel.

I. Shunted circuits with fire alarm system (code compliance)
1. All speakers within the facility must mute with activation of the fire alarm system. Life Time uses shunted power outlets and circuits to shut down power to specific audio systems. Installation should follow this guidance and be tested for functionality.

J. MDF and IDF equipment racks
1. All MDF and IDF equipment racks shall be bolted to the concrete floor by the AVC by appropriate means and hardware relative to the application. Please consult local building safety codes and GC requirements.
2. Seismic locations may require addition iso-base equipment application prior to permanently affixing equipment or server rack cabinets.
3. Follow OFE rack layout for equipment layout in rack.
4. All MDF and IDF equipment rack enclosures shall be properly grounded and bonded to the electrical earth grounding system as specified in the NEC. Please consult with the project EC to determine wire size and additional requirements.
5. The audio rack layout shall provide for power conditioning and amplifiers stack neatly at the lower end and follow with DSP, AV network devices, baluns etc. to the top with a blank rack panel between each separate component type. Appropriate thermal management shall be employed as required.
6. All cables shall have labels which depict source and destination which are clearly labeled and visible as stated above in item - 11. Cable Labeling Standards.
7. Network cabling from patch panel follow network cable color scheme:
    a. Purple depicts all QLAN.
    b. Green depicts AV items.
8. AV network switches – Netgear.
9. Do not exceed POE allowances.
10. Cable management shall be neat, organized, and stress free. Strict adherence to the Avixa Rack Building for Audio Visual Systems Standard is required. Items bulleted below must be calculated and applied in the rack building process.
    a. Velcro cable strap support every 12" (the use of nylon wire ties is prohibited).

b. Strain relief
c. Service loops
d. Horizontal cable management
e. Vertical cable management

11. Equipment rack thermal management shall be employed to ensure a nominal temperature of no more than 75 degrees Fahrenheit.
12. MDF to IDF interconnection runs shall be over fiber as Q-Lan.
13. Group fitness racks provided by others.
    a. Barre, Pilates, Yoga, Others etc. Small format racks built, populated, and installed/commissioned by AVC.

K. Terminations
1. Soldering
    a. Soldered connections shall follow the ISO 12224 soldiering specification.
    b. All connections require tinned wire tips and solder cups prior to application.
    c. Cold solder joints shall not be permitted.
    d. All connections shall be tested for continuity prior to application of heat shrink material.
    e. Heat shrink material sized appropriately for the specific wire gauge and over-all jacket is required on all connections in an effort to prevent shorts or possible electrical inter-connection between poles or adjacent conductors.
    f. In the event that accidental wire insulation burn-off has occurred which results in bare conductor exposure, the termination shall be void. The connection(s)/termination shall be re-terminated to correct the improper cable/termination state.
    g. If the accidental cable damage does not permit an optimal cable re-termination due to improper length, the cable must be re-pulled/replaced to assure correct fitment of the application.
2. Phoenix style
    a. Follow guidelines below:
        1) Remove the outer jacket of the cable with a cable stripper.
        2) Slide outer shrink wrap over the cable jacket.
        3) Outer shrink wrap should be measured to allow ¼” coverage over outer jacket and ¼” distance from connector housing where applicable.
        4) Spin the shield thoroughly, remove the bare wires. Pre-tinning the shield wires with solder.
        5) Place the cable shrink wrap on the shielded wire 1cm (about 0.39 in) from the end of the conductor ensuring that all bare wire is enclosed in the connector housing upon insertion.
        6) Insert the remaining conductors in appropriate configuration in the connector housing and secure the wires with the 2.5mm (about 0.1 in) flat-head screwdriver.
        7) Affix heat shrink wrap the outer jacket and conductors to form a secure bond without melting the jacket or insulation.
3. XLR
    a. Connections shall be soldered following soldering standards above.
        1) Pinout as follows:
            (a) Pin 1 = Ground
            (b) Pin 2 = Hot/Positive
            (c) Pin 3 = Cold/Negative
        2) Re-solder may be required with excess noise on speakers/sound system.
4. DMX

a. Connections shall be soldered following soldering standards above.
    1) Pinout as follows:
        (a) Pin 1 = Ground
        (b) Pin 2 = Cold/Negative
        (c) Pin 3 = Hot/Positive
    2) Re-solder may be required.

5. Terminal blocks and barrier strips
    a. Solder tin ends of bare wire. Provide heat shrink as part of AV standards.
    b. All barrier strip connections require spade lug termination on speaker cable pair ends prior to termination to barrier strip. Spade lugs are to be specifically sized for the individual cable conductor pairs and neatly terminated/crimped with no exposed copper conductor.
6. Miscellaneous
    a. Amplifier terminations shall require spade lugs specifically sized for the individual cable conductor pairs and neatly terminated/crimped with no exposed copper conductor.
    b. Undefined terminations must use AV standards.
7. Wall plates
    a. Wall plate terminations and face plate, regardless of connection type, shall be free of defects prior to adhesion to wall box.
    b. XLR/DMX connections shall be properly soldered and tested as noted above prior to on-plate connection. All XLR type soldered connections shall have heat shrink tubing applied to prevent shorts.
8. Wall and ceiling boxes
    a. Wall and ceiling boxes shall be properly grounded and bonded to the electrical earth grounding system as specified in the NEC.
    b. Box fill shall strictly adhere to article 314 of the NEC.
    c. Cable slack must be neatly dressed and free from abrasion, stress, or bare conductor conditions.
    d. Cable slack shall provide a minimum of six inches where applicable of working distance from the interior of the box for service or maintenance of internal or plate connections.
    e. Boxes shall be checked and free of scrap material, insulation, bare conductors or loose metallic objects prior to plate adhesion.
        1) Ceiling mounted boxes must be secured via manufacturer's recommendation. Ceiling grid support pencil rod(s) shall be utilized to support the added weight of the speaker against the ceiling grid. Support pencil rod shall be shot directly into the deck/ceiling or fastened to structural members with beam clamps or a combination of them and d-rings.

3.03 IDENTIFICATION AND LABELING

A. Each cable related to AV equipment must be labeled on each end. This includes, but is not limited to:
    1. Speaker cables
    2. Power cables
    3. Network cables
    4. Audio cables
B. Cable labeling shall follow the Avixa/Infocomm F501-01:2015 Cable Labeling for Audiovisual Systems printed standard.
C. Adaptation of other standards shall not be permitted unless specifically stated in writing by an authorized Life Time representative.
D. Each unique identifier (primary data element) should have a prefix and/or suffix determined by the accompanying project documentation.
E. Examples:

1. Signal type • Cable type designation
2. Room/floor/building number
3. Location designation of cables
4. Review and adhere to the standard as compliance is mandatory throughout.

3.04 TOOLS AND MATERIALS REQUIRED

A. Provide the following, including, but not limited to:
1. Safety equipment including hard hats, safety vests, steel toe boots, and eye protection.
2. Ladders
3. Scissor lift
4. Lockboxes and storage boxes
5. Hand tools
6. Termination tools
7. Hardware and screws
8. Anchors and ceiling support wires
9. Misc. materials/tools as needed to complete scope of work.

3.05 PROGRAMMING AND COMMISSIONING

A. General
1. The Contractor shall perform all required programming and adjustment of equipment to provide the functions described herein and in the drawings. Final programming of systems must be pre-approved by Life Time AV team.

B. Audio Processor Programming
1. Owner to provide base templates for Audio Signal Processor programming: Configure programming file for internal DSP signal routing and processing of audio DSP system to support all required and specified functions of the audio system, configure for remote control of required functions and to optimize the frequency response of each loudspeaker type used in the system for its specific application. DSP configuration shall provide for the following, via programmable internal routers, matrix mixers, mutes, volume controls, filters, equalizers, signal generators and dynamics processors. DSP shall be programmed with presets for all required selectable functions:
a. Independent audio source selection from each remote control for its speaker zone (minimum of 5 preset source selections programmed per control)
b. Independent volume control from each remote control for its speaker zone
c. Parametric Equalization for audio input sources (Pre-EQ)
d. Filter settings (high pass)
e. Equalization to optimize loudspeaker frequency response for music/program zones.
f. Equalization to a standardized masking EQ curve for each masking zone output of the DSP.
g. Dynamics processing if required.

C. Network switch configuration
1. Configuration with owner supplied configuration document.

D. Audio music levels
1. All Speakers must have great sound quality free from background noise, static, or other noticeable interference.
a. Workout Floor Music – Must be intelligible 71dB SPL A weighted at 5.5 ft above floor.
b. General Areas, Corridors, Lockers, Cafe, Salon, Spa - Must be intelligible 71dB SPL A weighted at 5.5 ft above floor.
c. Paging Levels - Must be intelligible at a level of 80 dB SPL A weighted at 5.5 ft above floor.
d. Paging Horns - Must be intelligible at a level of 80 dB SPL A weighted at 5.5 ft above floor.
e. Misc. Speakers – Must be intelligible 71dB SPL A weighted at 5.5 ft above floor.

3.06 ADJUSTMENTS AND TESTS

A. The Contractor shall adjust and calibrate all system controls for standard operation, provide all programming of programmable equipment, set internal jumpers as required and completely test all system functions.

B. The Contractor shall completely test, calibrate and adjust all components as recommended by manufacturers.

C. The Contractor shall completely test all functions of the remote control system to verify proper operation and coordinate the testing with the Consultant and Owner Representative.

D. The Contractor shall equalize the loudspeaker systems, utilizing professional 1/3 octave real-time analyzer equipment and pink-noise generator and /or an approved audio measurement platform (TEF, EASERA, SMART Live).

1. Optimize the equalization of the loudspeaker zones for speech and music reproduction and provide all necessary programming of EQ filters to meet the designated (ref. D.1.a. below) EQ curve for each speaker system type (wall mounted, ceiling mounted).
    a. The designated EQ curve to be used for the ambient sound system speaker systems shall provide flat (+-2 dB) response from 120 Hz to 4 Khz, with a high frequency rolloff of 3 dB per octave above 4 Khz to the natural response limits of the speaker devices. Apply parametric filters in cut mode, applying minimal boost only when gain reduction (cut) is not able to maintain the designated response curve. Provide up to 10 PEQ filters, applying as needed to maintain response curve.
    b. Measure and apply equalization with one (1) speaker active within the specific room or zone to avoid phase related filtering of the response. Apply the final equalized PEQ settings to both DSP channels feeding stereo audio output to the measured room or zone.
    c. Conduct a post EQ listening test in each room or zone, using music and speech audio program sources, in presence of designated Owner representative if/as elected by the Owner. Make final fine EQ adjustments if directed or required by Owner after listening tests.

3.07 INSTRUCTION OF OWNER

A. The contractor shall make available to the owner's representatives at least four (4) hours for demonstration and instruction in the use of the systems.

3.08 CLOSEOUT DELIVERABLES

A. Warranty statement document.

B. As-built architectural system drawings marked with redlines or finalized zone numbers/labels.

C. Q-Sys Designer Backup files.

D. IP Table with specific static IP’s are given by Life Time and should be noted in Excel format including all networked items with this information: Update and provide the following for each online device:

1. Device IP
2. Subnet Mask
3. Gateway
4. MAC Address
5. Switch Port
6. Switch Name
7. Usernames/ Passwords for each device documented if outside of Life Time standards.

E. Site photos

1. The contractor must provide site photos that are relevant to the individual room and job phase in a categorized digital format and file structure to Life Time upon completion of the project work.
2. Photos must include both close up and wide angle of all items as shown in scope. Label each picture and categorize folders for each area of facility.

F. Serial numbers for all equipment present in the final installation shall be presented to Life Time in a categorized digital format.

1. Make, model, serial number, and location.
2. Audio/visual rack mounted equipment make, model, serial number, and location.
3. Speaker systems make, model, serial number, and location.
4. Lighting equipment make, model, serial number, and location.
5. Temporary or portable, etc. audiovisual and DJ equipment make, model, serial number, and location.

G. As-built schematics
1. The contractor shall provide an as-built complete drawing set to Life Time upon completion of the assigned project work.
2. For all systems to include schematic/line drawings, floor plans, reflected ceiling plans and elevations.

3.09 FINAL CHECKOUT AND ACCEPTANCE

A. The Contractor shall verify that the system is complete and fully operational before requesting final approval and before scheduling system demonstration.
B. This Contractor shall be available to demonstrate the operation and use of the system to the Architect/Engineer and to the owner's representatives.
C. At the time of the demonstration, this Contractor shall furnish to the owner two (2) complete record manuals.
D. Final acceptance of the system will be given upon completion of all of the above requirements.
E. All components are free from dust, dirt, and fingerprints.
F. All components must be level, flush, and free from visible damage

3.10 MAINTENANCE SERVICE

A. This Contractor shall guarantee all equipment and workmanship to be free from defects for a period of one (1) year from substantial completion. The warranty period shall begin at the time of completion or at the time the Owner first receives beneficial use, whichever comes first.
B. When requested by Life Time within 12 months of date of Substantial Completion, provide on-site assistance for adjusting system to suit actual occupied needs and/or to maintain optimum system performance. Warranty issues shall be considered separately. Provide up to two visits to Project outside normal occupancy hours for this purpose. Include a minimum of 8 hours of on-site labor designated specifically for this purpose plus all necessary travel time. Any material costs and man-hours that extend beyond this provision may be billed to the owner provided such work and a prior cost estimate have been approved in advance by the owner.

END OF SECTION

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SECTION 27 2500
AUDIO/VISUAL SYSTEMS AND DISPLAYS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and General provisions of Contract including General and Supplementary Conditions and Division 1, specification sections, apply to the work of this section.

1.02 DESCRIPTION OF WORK

A. This section is centered around TV Service (DirecTV/Cable TV) displays and independent Audio/Video Systems including standalone Audio systems.

B. Provide equipment and hardware to provide a complete integrated audio distribution system and sound masking system. Furnish all specified materials, products, installation labor, programming, and testing work required for a complete and fully functioning system. Equipment notated on BOM as “OFE” is owner furnished equipment by Life Time.

1. Unless specified otherwise in the BOM, televisions, displays, digital signage PCs, portable sterior systems, music plays, and lighting systems are owner provided.

C. A conduit / raceway system required to support this equipment will be provided by others.

D. Programmingand configuration documents, where applicable, are provided by LIfe Time.

1.03 DEFINITIONS

A. AV or A/V = Audio Video
B. AVC = Audio Video Contractor
C. BOM = Bill of Material
D. CAD = Computer aided design
E. DMX = Digital Multiplex
F. DSP = Digital Signal Processor (for Audio)
G. DSP = Digital Signage Player (for Digital Signage)
H. EC = Electrical Contractor
I. GC = General Contractor
J. GF = Group Fitness Studio
K. IDF = Intermediate Distribution Frame (Secondary IT Closet)
L. IT = Information Technology (For this document its referred to as a department)
M. LAN = Local Area Network
N. LTF Standards = Life Time Standards
O. LVC = Low Voltage Contractor
P. MDF = Main Distribution Frame (Main IT closet)
Q. Misc. = Miscellaneous
R. NEC = National Electric Code
S. OFE = Owner Furnished Equipment (By Life Time)
T. POE = Power Over Ethernet
U. QLAN = Q-Sys local area network
V. Q-SYS = Manufacturer “Q-Sys”
W. SPL = Sound Pressure Level
X. SOW = Scope of Work
Y. UL = Underwriters Laboratories (Safety Standards
Z. XLR = External Line Return (Style of Audio connector)

1.04 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements listed below.

B. Installer Qualifications, Certifications, and General Knowledge:

1. CTS and Dante Certification by representative working directly on this project.
2. Dante Certification.
3. Training and experience with configuring Technicolor Com System.
4. DirecTV dish certified installer.
5. Experience with RF balancing on CATV systems.
6. Experience using digital CATV meter to balance system.
7. Experience with Bluebeam Revu, AutoCAD, Microsoft Windows 10, and Microsoft Office Suite.
8. Network switch configuration experience including, but not limited to, IP addressing, QoS, VLAN, and DHCP.

C. Manufacturers
1. The system shall be the product of the specified manufacturers, installed by an agency experienced in such work. The installation and connections of all equipment and tests of the operation of the system be made by a representative of the manufacturer or aforementioned installing agency.
2. Contractor / integrator providing this system must be manufacturer approved to furnish, install, maintain, and warranty the system equipment specified.

D. Installation
1. Installation of required raceways, conduits, and power receptacles shall be by the electrical contractor. The installation of communication outlets, wallplates, devices, and connections of all parts of the audio system shall be done by the A/V Contractor.

E. Programming
1. The Contractor shall employ the services of an experienced system programming specialist for the Digital Signal Processor/Control system provided under this specification and an experienced programmer for configuring and programming the audio DSP processing equipment.

F. NEC Compliance
1. Comply with NEC as applicable to construction and installation of system components and wiring.

G. UL Compliance
1. Where required, provide system equipment which is UL listed and labeled.

H. Licensing
1. The Communications Contractor shall be a low voltage contractor, licensed by the State of Minnesota.

1.05 SUBMITTALS

A. Product Data
1. Submit manufacturers' data on all equipment, including:
   a. Detailed equipment list indicating the manufacturer, model number, and quantity for each equipment item being provided or existing item being re-installed.
   b. Manufacturer's product data sheets for each new equipment item.
   c. Dimensions, rough-in drawings, installation instructions, and operation and maintenance, suitable for inclusion in maintenance manual.

B. Shop Drawings
1. Detailed wiring diagrams of the system. Diagrams shall show connection to each unit of system. Single-line block diagrams are not sufficient.
2. Detail drawings of all custom fabricated panels, connection wallplates and associated components being supplied.
3. Equipment rack elevation / layout diagrams (front face)

1.06 DELIVERY, STORAGE, AND HANDLING

A. Prior to acceptance, OFE shall be inspected for damage. If damage on boxes, pallets, or equipment is visible, the shipments shall be rejected and sent back to logistics company. Communicate damage to Life Time AV representative.

B. Store products in manufacturer's packaging. Keep dry and protect from damage until ready for installation.

C. Equipment must be kept locked up at all times in either an on-site storage container provided by AV Installation contractor or within the building in a designated secure location.

D. Contractor shall not install any product in construction areas where the product is subject to damage from water, dust, and construction debris.

E. Contractor is responsible for their own tools and AV components that they are installing. Keep them secure at all times.

PART 2 PRODUCTS

2.01 GENERAL

A. Provide materials in quantities listed in Life Time BOM for a complete and operational system as indicated herein and in the drawings.

B. Coordinate with system block diagrams for verification of specific quantity of equipment items required in each system.

2.02 OWNER PROVIDED EQUIPMENT/MATERIAL (OFE)

A. Reference BOM for purchasing equipment. Do not provide items indicated as OFE.

2.03 CONFLICTS WITH BOM

A. Present conflicts, errors, or omissions to Life Time AV representative for review and approval prior to purchasing.

2.04 SUBSTITUTIONS ON BOM

A. All substitutions outside of owner provided BOM must be presented and approved by Life Time AV representative.

2.05 MISCELLANEOUS MATERIALS

A. Provide list of construction required equipment for installations not called out specifically on BOM.

PART 3 EXECUTION

3.01 GENERAL

A. Wiring, except in equipment cabinets and where raceway or cable tray is provided, shall be routed open above suspended ceilings and in accessible walls and shall be in accordance with manufacturer's directions. All wiring in ceiling spaces shall be plenum rated. In accessible ceiling spaces, wiring shall be supported from ceiling structure at regular intervals of at least 48 inches. Cabling shall not be attached to or supported by ceiling tile support wires.

B. Final wiring connections shall be made and the entire system shall be tested and certified as working properly by an authorized representative of the Contractor. Written verification of test results shall be furnished to the Owner, Architect, and Engineer.

C. Identify and tag all cables with permanent type markers to denote location served.

D. All rack and in-cabinet wiring and cabling shall be neatly routed in plastic wiring duct or secured with tie wraps and routed along rack sides. All splices and connections shall be by plug, solder, or captive screw terminal strips, etc. Splices shall not hang in rack or cabinets.

E. All remotes, manuals, batteries, and spare cables shall be left in MDF Video Rack drawer.

3.02 INSTALLATION

A. Systems installation, cabling and rack building procedures shall fall in strict accordance with industry standards and manufacturer recommendations for safety and operation compliance.

B. Componentry installed during construction shall be either installed after finish carpentry and drywall sanding/construction is complete or covered in a method conducive to provide a dust free

environment for the installed items if the possibility of damage could occur to the item prior to first use by the client.

C. Final installation measures by the AVC shall include cleaning components to eliminate fingerprints, dust, or debris during the installation phase. Additional cleaning required by Life Time prior to first use by client will incur a cleaning fee payable by the AVC.

D. Install all equipment, components, accessories, terminal blocks, connectors and hardware necessary to provide a complete and operational system. Connector types and quantities shown in the drawings are representative and the Contractor shall be responsible to supply any additionally required connectors and wiring. Connectors shall be provided and installed as recommended by the manufacturer of the terminating equipment. All other wiring connections to connectors mounted on input plates and floor boxes shall be soldered connections or crimp (video) connections.

E. Provide and coordinate integration of this equipment with the CATV cabling distribution system specified under appropriate Division 27 specification section(s) and as indicated in the drawings.

F. All interconnects must be tied neatly with Velcro ties every 12”.

G. Zip ties are not allowed.

H. Cable minimum bend radius after installation shall be no less than 10 times the cable diameter.

I. MDF and IDF equipment racks
   1. All MDF and IDF equipment racks shall be bolted to the concrete floor by the AVC by appropriate means and hardware relative to the application. Please consult local building safety codes and GC requirements.
   2. Seismic locations may require addition iso-base equipment application prior to permanently affixing equipment or server rack cabinets.
   3. Follow OFE rack layout for equipment layout in rack.
   4. All MDF and IDF equipment rack enclosures shall be properly grounded and bonded to the electrical earth grounding system as specified in the NEC. Please consult with the project EC to determine wire size and additional requirements.
   5. The audio rack layout shall provide for power conditioning and amplifiers stack neatly at the lower end and follow with DSP, AV network devices, baluns etc. to the top with a blank rack panel between each separate component type. Appropriate thermal management shall be employed as required.
   6. All cables shall have labels which depict source and destination which are clearly labeled and visible as stated above in item - 11. Cable Labeling Standards.
   7. Network cabling from patch panel follow network cable color scheme:
      a. Purple depicts all QLAN.
      b. Green depicts AV items.
   8. AV network switches – Netgear.
   9. Do not exceed POE allowances.
   10. Cable management shall be neat, organized, and stress free. Strict adherence to the Avixa Rack Building for Audio Visual Systems Standard is required. Items bulleted below must be calculated and applied in the rack building process.
      a. Velcro cable strap support every 12” (the use of nylon wire ties is prohibited).
      b. Strain relief
      c. Service loops
      d. Horizontal cable management
      e. Vertical cable management
   11. Equipment rack thermal management shall be employed to ensure a nominal temperature of no more than 75 degrees Fahrenheit.
   12. MDF to IDF interconnection runs shall be over fiber as Q-Lan.
   13. Group fitness racks provided by others.

a. Barre, Pilates, Yoga, Others etc. Small format racks built, populated, and installed/commissioned by AVC.

J. Satellite systems
   1. DirecTV is the preferred satellite system vendor for Lifetime installations.
   2. New Satellite account information will be supplied and activated by Life Time. The AVC will coordinate and supply the dish installation. Dish installation must be done to DirecTV standards and includes, but is not limited to the following:
      a. Provide 8x8x16 cinder blocks for non-penetration roof mounts.
      b. Non-penetration mount shall have a rubber mat between rooftop and dish mount.
      c. Provide dish grounding to DirecTV standards.
      d. Terminations must include dielectric grease.
      e. Must include drip loops.
   3. The LVC provides terminal feeds from the MDF to satellite dish/LNB. Connect cabling to Dish.
   4. DIRECTV signal is modulated onto RF channels which are then displayed via set top boxes at each cardio display.
   5. All display, head end, and set top boxes are provided by Sonify as well as the satellite dish, LNB/LNA, and satellite dish roof mount.
   6. Dish signal strength must be free from obstructions.

K. Cable TV systems
   1. New cable TV services will be supplied and activated by Life Time.
   2. The AVC will provide and connect coaxial cable feeds from cable TV system with MDF to Video Rack.

L. Display (TV) mounting procedures
   1. Wall Mount:
      a. Wood or metal stud wall covered with gypsum board (drywall) the studs shall be a minimum of 2" x 4" nominal size. Do not install over gypsum board with a thickness greater than 5/8".
         1) The structural wall is required to be able to support five times the load of mounted display and equipment.
      b. Solid concrete
         1) The wall shall be at least 8" thick with a minimum compressive strength of 2000 psi. The cinder blocks shall meet ASTM (American Society for Testing and Materials) C-90 specifications and have a minimum nominal width of 8". Mortar joints are not approved to be used for mounting displays or other materials in any case.
         2) The structural wall is required to be able to support five times the load of mounted display and equipment.
      c. Cinder block wall
         1) The cinder blocks must meet ASTM C-90 specifications and have a minimum nominal width of 8”. Mount securely in a solid portion of the block, generally 1" (25 mm) minimum from the side of the block. A standard electric drill on slow setting shall be used to drill the hole in lieu of a hammer drill to avoid breaking out the back of the hole when entering a void or cavity. The installer shall not attach concrete expansion anchors to concrete or cinder block covered with drywall or other finishing material.
         2) The structural wall must support five times the load of mounted display and equipment.
      d. Components behind TV including, but limited to, TV tuner, digital signage PC, or power conditioners must be strapped to wall and accessible to service from side of TV without having to remove display to access.
      e. Cabling/adapters must not be visible and tied with Velcro.
   2. Ceiling pole mount for TVs, projectors, or others

a. Ceiling pole mounts shall utilize a combination of a ceiling plate adapter directly anchored to the deck/ceiling or securely fastened to uni-strut utilizing a combination of spring nuts, threaded rod, and the appropriate combinations of machine nuts and washers.
b. Adapter plates shall have a 6x6 hole pattern and withstand five times the load of the mounted display and equipment.
c. Uni-strut channel shall be mounted securely by either spanning and passing through structural members attached with beam clamps or directly shot into the deck/ceiling with the appropriate fastener. The two end points of the uni-strut channel must pass through structural members to ensure stability and proper load dispersion.
d. Back-to-back display mounting applications shall follow also follow the above specifications and the manufacturers' direct specifications for sway and weight ratio.
e. The mounting of electronic DSP (Digital Signage Player) installation location shall be strapped to the back of the mounted display device and accessible for serviceability.
f. Routing of audio-visual cables shall be neatly tucked into the extension pole or run through a flex material and strapped to the extension pole.
g. Projectors must be mounted flush with top of visible screen.

3. Millwork display mounting
   a. Flat panel displays mounted in millwork shall be directly coordinated with the architectural millwork drawing set. The display mount shall be fastened securely to the millworkers supplied backing and a minimum air gap of no less than six inches shall be observed on all sides for adequate display heat dissipation/ventilation.
   b. In complete enclosure applications, proper thermal management practices shall be required to always keep display and electronics temperature within the sealed/trimmed enclosure to no more than 80% of the maximum allowable operating temperature per the individual manufacturer's specifications. Exhaust fans and temperature sensors shall be utilized to ensure safe operating conditions and electronic equipment operational longevity that does aid to harm or void the manufacturers equipment warranty.
   c. The structural wall must support five times the load of mounted display and equipment.
   d. The mounting of electronic DSP and tv tuner and installation location shall be behind the display device mounted to the internal structure of the millwork enclosure.
   e. Routing of audio-visual cables shall be tucked neatly behind the display device and strapped with strain relief and allow for removal of the display device prior to cable disconnection. Visible or unmanaged cables shall not be permitted.

M. Projectors
1. Ceiling mounted projectors must follow pole mounted structural requirements above.
2. Projector positioning and height must be calculated based on throw distance and approved by Life Time AV representative.
3. Projector image must fill screen exactly with no keystone or stretching allowed.
4. Projectors must be level
5. Projectors must be 8ft above floor.
6. Projector ceiling storage boxes must be used, include power within, and no wires visible routing up pole to ceiling storage.

N. Projector screens
1. Projector screens must be secured via manufacturer directions/hardware requirements.
   a. Must be secured to ceiling or walls.
2. Projector screens must be adjusted to be within 1" of overhead case, unless AV representative approved.

O. Standalone audio/video systems (i.e. Group Fitness, Cycle, Yoga, Barre, Stereo/Video Systems)
1. Racks must follow wiring and rack layouts.

2. Devices must be accessible on networks as shown on drawings. Follow IP information and give MAC addresses.
3. Programming provided by Life Time. Provide minor adjustments such as labels and levels.

P. Portable systems
1. Receive owner provided portable systems at facility and secure.

Q. Bluetooth
1. Bluetooth must not have interference with any other wireless device. Must work within 30 ft per manufacturer specifications. Notify Life Time AV representative if interference cannot be mitigated.

R. Interconnects and Cabling Specifications
1. DMX lighting control cabling
   a. All DMX cabling shall conform to ANSI e1.27-2-2009 (r2014), recommended practice for permanently installed control cables for use with ANSI e1.11 (DMX512-a) and USITT DMX 512/1990 products.
   b. The maximum total length of a daisy-chain DMX control run is 300 meters (1,000 feet) using the lowest grade cabling conforming to ANSI e1.27-2-2009 (r2014). Improved wire gauge and shielding can extend this limitation.
   c. Some additional devices such as repeaters or splitters may also extend this limitation. Consult manufacturer to validate any limitation extensions.
   d. Every DMX control run must be terminated after the last DMX control module in a daisy-chain sequence with a DMX terminator. All cables shall be UL listed type cmp (plenum) or cm/cmr (non-plenum) as required.
   e. All cables shall meet or exceed the following performance requirements:
      1) Nominal impedance: 120 ohm
      2) Nominal outer jacket OD of 0.271”
      3) Meet or exceed USITT standards for DMX 512 cabling specifications
      4) Core conductor AWG - 24AWG (7x32) stranded tc
      5) (4) conductor cable with foil and tc braid
      6) Insulation type foam pe, .025” wall
      7) Drain wire 24AWG (7x32) stranded tc
      8) Termination connectors shall be Nuetrik DMX 3 pin m/f
2. HDMI interconnection cables
   a. All HDMI interconnect cabling shall comply with the HDMI 2.1 specification developed by the HDMI consortium.
   b. All cables shall meet or exceed the following performance requirements:
      1) Frame rate: 24, 25, 30, 50 or 60fps
      2) Chroma sampling: 4:4:4, 4:2:2, or 4:2:0
      3) Bit color depth: 8 bits per color
      4) Signal type: HDMI 2.0
      5) Max video data rate: 18.0 gbps (6.0 gbps per color)
      6) Resolution range: up to 4k @ 60 Hz (4096x2160), uhd @ 60 Hz
      7) 8-bit color depth, max. 18.0 gbps data rate
      8) Voltage: 30v
      9) Pair impedance: 100 ohms +/- 10 ohms
      10) Attenuation:
         (a) At 0.3 – 0.825 GHz ≤5 dB per 3 m
         (b) At 0.825 - 2.475 GHz: ≤12 dB per 3 m
         (c) At 2.475 - 4.125 GHz: ≤20 dB per 3 m

(d) At 4.125 - 5.100 GHz: ≤25 dB per 3 m

11) Fext: ≥20 dB per 3 m

12) Skew:

(a) Intrapair: ≤112 ps per 3 m

(b) Intrapair: ≤1.78 ns per 3 m

3. Display port interconnection cables

a. All cables shall meet or exceed the following performance requirements:

1) Frame rate: 24, 25, 30, 50 or 60fps

2) Chroma sampling: 4:4:4, 4:2:2

3) Bit color depth: 8, 10 or 12 bits per color

4) Signal type: DisplayPort 1.2, HDCP 1.4, HDCP 2.3

5) Max video data rate: 21.6 gbps (5.4 gbps per lane)

6) Resolution range: up to 4k @ 60 Hz (4096x2160), uhd @ 60 Hz

7) 12-bit color depth, max. 21.6 gbps data rate

8) Voltage: 40v

9) Pair impedance: 100 ohms +/- 10 ohms

10) Attenuation:

(a) At 0.3 – 0.825 GHz ≤5 dB per 3 m

(b) At 0.45 - 1 GHz: ≤7.7 dB per 3 m

(c) At 1 - 2 GHz: ≤12.6 dB per 3 m

(d) At 2 - 3 GHz: ≤17.5 dB per 3 m

(e) At 3 - 4 GHz: ≤22.4 dB per 3 m

(f) At 4 - 5 GHz: ≤27.3 dB per 3 m

(g) At 5 - 7 GHz: ≤37.1 dB per 3 m

(h) Fext: ≥20 dB per 3 m

(i) Skew:

(1) Intrapair: ≤50 ps per 3 m

(2) Intrapair: ≤4 ns per 3

3.03 IDENTIFICATION AND LABELING

A. Each cable related to AV equipment must be labeled on each end. This includes, but is not limited to:

1. Speaker cables
2. Power cables
3. Network cables
4. Audio cables

B. Cable labeling shall follow the Avixa/Infocomm F501-01:2015 Cable Labeling for Audiovisual Systems printed standard.

C. Adaptation of other standards shall not be permitted unless specifically stated in writing by an authorized Life Time representative.

D. Each unique identifier (primary data element) should have a prefix and/or suffix determined by the accompanying project documentation.

E. Examples:

1. Signal type • Cable type designation
2. Room/floor/building number
3. Location designation of cables
4. Review and adhere to the standard as compliance is mandatory throughout.

3.04 TOOLS AND MATERIALS REQUIRED

A. Provide the following, including, but not limited to:

1. Safety equipment including hard hats, safety vests, steel toe boots, and eye protection.
2. Ladders

3. Scissor lift
4. Lockboxes and storage boxes
5. Hand tools
6. Termination tools
7. Hardware and screws
8. Anchors and ceiling support wires
9. Misc. materials/tools as needed to complete scope of work.

3.05 PROGRAMMING AND COMMISSIONING

A. General
   1. Provide all initial setup and programming required for operation of the digital signage server including coordinating and testing network connectivity and web-based accessibility and shall utilize manufacturer provided assistance as needed and available.

B. Digital Signage
   1. Digital Signage players provided by Life Time are pre-programmed. Confirm these players are connected to the Life Time Cisco Network and are accessible by Life Time digital signage team.
   2. Coordinate with Life Time Digital signage team to align aspect ratio and naming.

C. Audio Fetch
   1. Audiofetch listening device(s) must be programmed to Life Time channel lineup.
   2. All TV audio must be balanced on member app during configuration.
   3. Audio must be calibrated for delay to minimize delay between audio and video.

D. Technicolor COM system (for DirecTV satellite distribution)
   1. Configure COM system to LIfe Time standards.
   2. HD programming must follow Life Time provided channel lineup.
   3. HD Channels must be programmed with IP information provided, live on Life Time internal network.
   4. Licensing must be applied per channel.
   5. Each QAM Carrier must be enabled with “Clear HD”, also known and “In the Clear”.
      a. Coordinate the approval process with Technicolor and DirecTV. Life Time will provide the signed paperwork with grandfathered agreement with DirecTV.
   6. Output of COM system “QAM” coax output must be measured between +30dBmV and +50dBmV.
   7. Electronic programming guide channel should be activated but NOT included in channel lineup. Program guide to include channel information to be broadcasted to cardio equipment and TV tuners.

E. TV settings
   1. Each TV should be set to operate 24/7. Follow these settings:
      a. TVs must be set with auto-off disabled.
      b. Set time on each display.

F. TV tuners
   1. Follow the owner provided configuration documentation for initial setup
   2. Life Time will provide the desired Channel TV lineup with QAM channel numbers broadcasted from TV distribution. Provide coordination with Life Time AV representative to verify subscriber network channels to be deleted for inserting local channels and determining channels for channel elimination filters. The channel lineup indicated on the drawings shall be verified by the contractor and coordinated with the owner.
   3. Close captioning must be visible on large TVs.
   4. Channel information and TV channel numbers shall be visible on TV tuner.

G. Programming cardio equipment TV tuners

1. Each TV attached or built in, with RF distribution, must include every channel in channel lineup. Must be clear from static, pixelization, and other interference.
2. Audio must be verified at each piece of equipment with headphones. Clear from any static or glitching.
3. Closed captioning must be visible upon demand on each TV.

H. Projectors
1. Projectors must fill entire screen.
2. Set to auto-off after four (4) hours.

I. Wireless microphone systems
1. Wireless microphone systems must not interfere with other wireless devices in the facility or outside. Frequency scans must be performed to ensure no interference.

J. Portable audio systems
1. Each must be setup, tested for audio, wireless mic configured for facility, and no interference.

3.06 ADJUSTMENTS AND TESTS

A.

B. The Contractor shall completely test, calibrate, and adjust all components as recommended by manufacturers.

C. The Contractor shall completely test all functions of the remote control system to verify proper operation and coordinate the testing with the Consultant and Owner Representative.

3.07 INSTRUCTION OF OWNER

A. The Contractor shall provide Owner user training on all operational aspects of new equipment provided for the system and shall provide up to eight (8) hours of instruction (in conjunction with manufacturer) for operation of the new video messaging system. Training information, sign-in sheets shall be included in as-built documentation.

3.08 CLOSEOUT DELIVERABLES

A. Warranty statement document.

B. As-built architectural system drawings marked with redlines or finalized zone numbers/labels.

C. TV tuner cloned image backup file(s).

D. IP Table with specific static IP's are given by Life Time and should be noted in Excel format including all networked items with this information: Update and provide the following for each online device:
1. Device IP
2. Subnet Mask
3. Gateway
4. MAC Address
5. Switch Port
6. Switch Name
7. Usernames/ Passwords for each device documented if outside of Life Time standards.

E. Site photos
1. The contractor must provide site photos that are relevant to the individual room and job phase in a categorized digital format and file structure to Life Time upon completion of the project work.
2. Photos must include both close up and wide angle of all items as shown in scope. Label each picture and categorize folders for each area of facility.

F. Serial numbers for all equipment present in the final installation shall be presented to Life Time in a categorized digital format.
1. Display/television make, model, serial number, and location
2. Audio/visual rack mounted equipment make, model, serial number, and location.
3. Lighting equipment make, model, serial number, and location.
4. Temporary or portable, etc. audiovisual and DJ equipment make, model, serial number, and location.

G. As-built schematics
    1. The contractor shall provide an as-built complete drawing set to Life Time upon completion of the assigned project work.
    2. For all systems to include schematic/line drawings, floor plans, reflected ceiling plans and elevations.
H. Each wireless microphone system frequency in Excel and photos.

3.09 FINAL CHECKOUT AND ACCEPTANCE

A. The Contractor shall verify that the system is complete and fully operational before requesting final approval and before scheduling system demonstration.
B. This Contractor shall be available to demonstrate the operation and use of the system to the Architect/Engineer and to the owner's representatives.
C. At the time of the demonstration, this Contractor shall furnish to the owner two (2) complete record manuals.
D. Final acceptance of the system will be given upon completion of all of the above requirements.
E. All components are free from dust, dirt, and fingerprints.
F. All components must be level, flush, and free from visible damage

3.10 MAINTENANCE SERVICE

A. This contract shall include a written warranty for the installed system, including all equipment and workmanship, as a guarantee to correct any defects and failures for a period of 12 months. The warranty period shall begin at the time of completion (fully tested and accepted) or at the time the owner first receives beneficial use, whichever comes first. Within this 12 month warranty period, the entire system shall be kept in proper operating condition at no charge to the Owner.
B. When requested by owner within 12 months of date of Substantial Completion, provide on-site assistance for adjusting system to suit actual occupied needs and/or to maintain optimum system performance. Warranty issues shall be considered separately. Provide up to two visits to Project outside normal occupancy hours for this purpose. Include a minimum of 8 hours of on-site labor designated specifically for this purpose plus all necessary travel time. Any material costs and man-hours that extend beyond this provision may be billed to the owner provided such work and a prior cost estimate have been approved in advance by the owner.

END OF SECTION

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SECTION 27 4133
BROADBAND TELEVISION DISTRIBUTION SYSTEM

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:
   1. Broadband Television Distribution System: Equipment, coaxial cabling, and components configured for the distribution of television signals.

1.03 DEFINITIONS

A. Agile Receiver: A broadband receiver that can be tuned to any desired channel.
B. Broadband: For the purposes of this Section, wide bandwidth equipment or systems that can carry signals occupying in the frequency range of 54 to 1002 MHz. A broadband communication system can simultaneously accommodate television, voice, data, and many other services.
C. Carrier: A pure-frequency signal that is modulated to carry information. In the process of modulation, it is spread out over a wider band. The carrier frequency is the center frequency on any television channel.
D. CATV: Community antenna television; a communication system that simultaneously distributes several different channels of broadcast programs and other information to customers via a coaxial cable.
E. CEA: Consumer Electronics Association.
F. dBmV: Decibels relative to 1 mV across 75 ohms. Zero dBmV is defined as 1 mV across 75 ohms. dBmV = 20 log 10(V1/V2) where V1 is the measurement of voltage at a point having identical impedance to V2 (0.001 V across 75 ohms).
G. Headend: The control center of the master antenna television system, where incoming signals are amplified, converted, processed, and combined into a common cable along with any locally originated television signals, for transmission to user-interface points.
H. MATV: Master antenna television; a small television antenna distribution system usually restricted to one or two buildings.
I. RF: Radio frequency.

1.04 SYSTEM DESCRIPTION

A. The system shall consist of a DirecTV or Cable TV service transmitted over a a coaxial cable distribution system.
B. Headend equipment shall consist of receiving antennas and associated signal amplification and equalization.
C. Distribution of DirecTV or Cable TV service signals. Obtain signal levels, and noise and distortion characteristics from service provider as the point of departure for system layout and final equipment selection.
D. Cable distribution system consisting of coaxial cables, user interfaces, signal taps and splitters, RF amplifiers, signal equalizers, power supplies, and required hardware complying with IEEE 802.7 and resulting in performance parameters specified in this Section.
E. Hardware Requirements: Use modular, plug-in, solid-state electronic components. Mount amplifiers and other powered equipment in head end racks.

1.05 SUBMITTALS

A. Product Data: For each type of product indicated.
   1. Equipment List: Include every piece of equipment by model number, manufacturer, serial number, location, and date of original installation. Add testing record of each piece of adjustable

equipment, listing name of person testing, date of test, and description of as-left set points.

2. Source quality-control test reports on coaxial cable sweep tests.

B. Field quality-control test reports.

C. Operation and Maintenance Data: For head-end and distribution system to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Lists of spare parts and replacement components recommended to be stored at the site for ready access.
2. Operating Instructions: Provide two sets. Furnish instructions so the users of the system will know how to fully operate the system.
3. As-Built Drawings: Provide one set. These drawings shall include any changes made to the system during installation. Include circuit diagrams and other information necessary for the proper operating and maintenance of the system.
    a. Include dimensioned plan and elevation views of components and enclosures. Show access and workspace requirements.
4. Include all warranty information as specified.

D. Record Documents and Drawings:

E. This contractor shall furnish to the Owner two (2) complete as-built manuals. These manuals shall be assembled in a loose-leaf binder and shall contain the following:

1. System Operating Instructions
2. System Functional Block Diagram(s)
3. System Schematic Diagram(s)
4. Component Operating Manual(s)
5. Component Service Manual(s)
6. System Wiring List(s)

1.06 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements listed below.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NECA 1.

D. Comply with NFPA 70 (National Electrical Code).

E. UL Compliance: Provide equipment and components that are UL listed and labeled.

1.07 COORDINATION

A. Coordinate size and location of raceway system, and provisions for electrical power to equipment of this Section.

B. Coordinate Work of this Section with requirements of DirecTV or Cable TV service provider.

1.08 GUARANTEES AND WARRANTIES

A. This contract shall include a written warranty for the installed system, including all equipment and workmanship, as a guarantee to correct any defects and failures for a period of 12 months. The warranty period shall begin at the time of completion (fully tested and accepted) or at the time the owner first receives beneficial use, whichever comes first. Within this 12-month warranty period, the entire system shall be kept in proper operating condition at no charge to the Owner.

1.09 MAINTENANCE SERVICE

A. System Adjustments: When requested by owner within 12 months of date of Substantial Completion, provide on-site assistance for adjusting system to suit actual occupied needs and/or to maintain optimum system performance. Warranty issues shall be considered separately. Provide up to two visits to Project outside normal occupancy hours for this purpose. Include a minimum of 8 hours of on-site labor designated specifically for this purpose plus all necessary travel time. Any material costs

and man-hours that extend beyond this provision may be billed to the owner provided such work and a prior cost estimate have been approved in advance by the owner.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: All listed manufacturers are subject to compliance with the requirements specified herein.

B. Equipment shall be made by manufacturers listed herein are considered approved for bidding on this project. Where specific makes and models are referred to, the intention is to establish a minimum level of performance and features. Materials shall never be ordered based solely upon model numbers, but rather foremost upon specifications, descriptions, and applications of such materials. Any perceived inconsistencies shall be discussed with the Life Time AV representative prior to bid.

C. Any equipment or materials proposed as equivalent to the system herein specified, must be so proven by the contractor. Provide manufacturer's name, model numbers, and two (2) copies of product data documentation. Once such information is provided, the alternate manufacturer may be approved only by the specifying authority. Alternate manufacturers are allowed only after the specifying authority modifies this contract (via addendum) to include such manufacturers as equivalents.

2.02 SUBSTITUTIONS

A. The contractor shall submit proposed alternates to the Life Time AV representative at least ten (10) working days prior to the bid date.

2.03 BROADBAND EQUIPMENT

A. Description: Signal-source components, signal-processing and amplifying equipment, distribution components, and interconnecting wiring. System shall receive signals from sources, amplify and process them, and distribute them to outlets for receiving sets. Equipment shall translate UHF channels to VHF channels before distribution to outlets.

B. Identification of Signal Sources and Channels Distributed: Coordinate all such information directly with the owner and their signal service provider.

C. Broadband System Qualitative Performance Requirements: Reception quality of color-television program transmissions at each system outlet from each designated channel and source shall be equal to or superior than that obtained with performance checks specified in Part 3 "Field Quality Control" Article, using a standard, commercial, cable-ready, color-television receiver.

D. Broadband System Quantitative Performance Requirements: Level and quality of signal at each outlet from each designated channel and source shall comply with Specifications below when tested according to 47 CFR 76.

2.04 BROADBAND HEAD-END COMPONENTS

A. Manufacturers:
   1. Blonder Tongue Laboratories, Inc.
   2. Cabletronix, Inc.
   3. Technicolor
   4. ZeeVee

B. Head-end Equipment: Channel mixers, processors for channel translation, broadband amplifier, single-channel amplifiers, and/or combining networks for receiving off-air television and FM signals and outputting the signals to cable distribution system. Equip coaxial down leads of the off-air antennas with preamplifiers to send signals at strength required by head-end.
   1. House the units in within the head end rack.
   2. All head-end equipment shall be 19" rack mountable in the floor-mounted rack(s).

C. Broadband Amplifier:
   1. Frequency Range: 47 to 860 MHz.
   2. Frequency Response: Plus or minus 1.0 dB across passband.

3. Maximum Noise: 10 dB.
4. Minimum Return Loss: 16 dB.
5. I/O Impedance: 75 ohms.
6. Design Basis: Broadband Indoor Distribution Bi-directional Amplifier, 47-860 MHz frequency range, Blonder Tongue RMDA series or approved equivalent. Determine quantity and size as required for proper signal level.

2.05 DISTRIBUTION COMPONENTS

A. Cable Fittings shall be male F-connectors designed specifically for the specified RG-6/11 and ½" hard-line cable. Manufacture of cable fittings shall be Gilbert, LRC, or approved equivalent.
   1. Type F, 75 ohms.
   2. Compression-type cable fitting.
   3. Anti-corrosion nickel-plated finish.

B. Couplers (or taps) for connections of coaxial signal distribution in telecommunication rooms shall have bandwidth performance of 5 to 1000 MHz, be available in 2-way to 8-way configurations, be available in attenuations from 8-30 dB (provide appropriate attenuation to meet design and signal distribution requirements, and have 120 dB RFI shielding. Approved manufacturers are Cable Tronix, Blonder-Tongue, or approved equivalent.

C. Splitters for distribution of coaxial backbone cabling shall have bandwidth performance of 5 to 1000 MHz, be available in 2-way to 8-way balanced configurations (or 3-way unbalanced), and have 120 dB RFI shielding. Provide splitters as required to meet signal distribution requirements. Approved manufactures are Cabletronix, Blonder-Tongue, or approved equivalent.

D. All cable fittings shall be compression-type with anti-corrosion nickel-plated finish.

E. Provide Type-F terminating resistors for all unused taps of splitters and directional couplers.

F. Cable System Power Supplies: Plug-in modular construction, with surge, short circuit, and overload protection.

G. Signal Traps: Packaged filters tuned to interference frequencies encountered in Project.

H. Attenuators: Passive, of fixed value, used to balance signal levels.

I. User-Interface Device: Flush, female-type outlets, designed for installation in data faceplate, mounting in standard outlet box, with metallic parts of anodized brass, beryllium copper, or phosphor bronze.
   1. Cable Connector: Female, Type F. Insert to be pass-thru RF-Type connector for mating with F type male connectors.
   2. Wall Plates: specified in section 271350
   3. Attenuation: Less than 0.1 dB.
   4. Voltage Standing-Wave Ratio: Less than 1.15 to 1.

2.06 COAXIAL CABLING

A. Cable Characteristics: Broadband type, recommended by cable manufacturer specifically for broadband CATV and data transmission applications. Coaxial cable and accessories shall have 75-ohm nominal impedance with a return loss of 20 dB minimum from 5 to 1000 MHz, and shall be listed to comply with NFPA 70, Articles 810 and 820.

B. NFPA and UL compliance, listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1655 and with NFPA 70 "Radio and Television Equipment" and "Community Antenna Television and Radio Distribution" Articles. Types are as follows:
   1. CATV Cable: Type CATV or CATVR.
   2. CATV Plenum Rated: Type CATVP, complying with NFPA 262.
   3. CATV Riser Rated: Type CATVR, complying with UL 1666.
   4. CATV Limited Rating: Type CATVX.

C. Indoor RG6 Cable shall comply with the following requirements:
   1. Type RG6, quad shielded with CL2P jacket.

a. Nominal impedance: 75 ohm +/-3.0 Ohm
b. Nominal velocity of propagation: 83%
c. Nominal capacitance: 16.2 pf/ft. (53.1 pf/m)
d. Temperature rating: -40ºc +80ºc temp
e. Core AWG: 18
f. Nominal core o.d.: 0.180in (4.57mm)
g. Nominal o.d.: 0.275 in (6.99 mm)
h. Nominal delay: 1.24 ns/ft
i. Nominal conductor dc resistance 20ºc: 28.0 / 1000 ft.
j. Structural return loss:
k. 23 dB min, 5-85 MHz
l. 21 dB min, 851-3000 MHz

2. Nominal attenuation:
   a. 1.0 MHz - 0.24dB/100 ft
   b. 3.6 MHz - 0.45dB/100 ft
   c. 10.0 MHz - 0.72dB/100 ft
   d. 71.0 MHz - 1.70dB/100 ft
   e. 135.0 MHz - 2.10dB/100 ft
   f. 270.0 MHz - 2.97dB/100 ft
   g. 360.0 MHz - 3.43dB/100 ft
   h. 720.0 MHz - 4.95dB/100 ft
   i. 1000.0 MHz - 5.89dB/100 ft
   j. 3000.0 MHz - 10.67dB/100 ft
3. Attenuation per 100 feet shall not exceed 7.3 dB at 1000 MHz.
4. Plenum rated, UL Listed type CMP marking on cable.
5. Product identifications markings at regular intervals on cable
6. White in color (cable jacket) unless noted otherwise
7. Approved products:
   a. CommScope #7461604
   b. Equal by West Penn
   c. Equal by Belden
   d. Or prior approval.

D. Outdoor RG6 Cable shall comply with the following requirements:
1. Type RG6, quad shielded with sunlight resistant rated jacket.
2. Nominal impedance: 75 ohm +/-3.0 Ohm
   a. Nominal velocity of propagation: 83%
   b. Nominal capacitance: 16.2 pf/ft. (53.1 pf/m)
   c. Temperature rating: -40ºc +80ºc temp
   d. Core AWG: 18
   e. Nominal core o.d.: 0.180in (4.57mm)
   f. Nominal o.d.: 0.275 in (6.99 mm)
   g. Nominal delay: 1.24 ns/ft
   h. Nominal conductor dc resistance 20ºc: 28.0 / 1000 ft (about 304.8 m).
   i. Structural return loss:
   j. 23 dB min, 5-85 MHz
   k. 21 dB min, 851-3000 MHz
3. Nominal attenuation:
   a.

b. 3.6 MHz - 0.45dB/100 ft
c. 10.0 MHz - 0.72dB/100 ft
d. 71.0 MHz - 1.70dB/100 ft
e. 135.0 MHz - 2.10dB/100 ft
f. 270.0 MHz - 2.97dB/100 ft
g. 360.0 MHz - 3.43dB/100 ft
h. 720.0 MHz - 4.95dB/100 ft
i. 1000.0 MHz - 5.89dB/100 ft

4. 3000.0 MHz - 10.67dB/100 Attenuation per 100 feet shall not exceed 7.3 dB at 1000 MHz.
5. Product identifications markings at regular intervals on cable.
6. Black in color (cable jacket).
7. Approved manufacturers:
   a. CommScope
   b. West Penn
   c. Belden
   d. Or prior approval.

E. Indoor RG11 Cables shall comply with the following requirements:
1. Type RG11, quad shielded with CL2P jacket.
2. Nominal impedance: 75 ohms.
   a. Nominal velocity of propagation: 84%
   b. Nominal capacitance: 16 pf/ft. (53.1Pf/m) temperature rating: -40ºc +80ºc
   c. Core AWG: 14
   d. Nominal core o.d.: 0.064in
   e. Nominal o.d.: 0.400 in
   f. Nominal delay: 1.21 ns/ft
   g. Nominal conductor dc resistance 20ºc: 25 /1000 ft.
3. Structural return loss:
   a. 23 dB min, 5-85 MHz
   b. 21 dB min, 851-3000 MHz
4. Nominal attenuation:
   a. 1.0 MHz - 0.16dB/100 ft
   b. 3.6 MHz - 0.29dB/100 ft
   c. 10.0 MHz - 0.46dB/100 ft
   d. 71.5 MHz - 1.09dB/100 ft
   e. 135.0 MHz - 1.47dB/100 ft
   f. 270.0 MHz - 2.09dB/100 ft
   g. 360.0 MHz - 2.45dB/100 ft
   h. 720.0 MHz - 3.58dB/100 ft
   i. 1000.0 MHz - 4.30dB/100 ft
   j. 3000.0 MHz - 8.20dB/100 ft
5. Attenuation per 100 feet shall not exceed 4.3 dB at 1000 MHz.
6. Plenum rated, UL Listed type CMP marking on cable.
7. Product identifications markings at regular intervals on cable.
8. White in color (cable jacket).
9. Approved manufacturers:
   a. CommScope
   b. West Penn
   c. Belden or prior approved equivalent.
   d. Or prior approval.

F. Coaxial trunk cable from the main telecommunications room to telecommunications rooms shall comply with the following requirements:
    1. Trunk and distribution coaxial cable.
        a. Copper-clad aluminum wire covered with foam FEP dialectic aluminum tube shield and PVC jacket; overall cable diameter of 0.536 inches.
        b. Nominal impedance 75 ohm
        c. Attenuation per 100 feet shall not exceed 3.78 dB at 1000 MHz.
        d. Plenum rated. UL Listed type CMP marking on cable.
        e. Product identifications markings at regular intervals on cable.
        f. White in color (cable jacket).
        g. Approved products:
            1) CommScope #2312V
            2) West Penn equal.
            3) Belden equal.
            4) Or prior approval.

G. Station Cords:
    1. For each user-interface device installed, provide a 10-foot (or other length as noted) RG-6/U 18 AWG coax cable terminated at both ends for connection to owner-provided audio/video electronics.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine pathway elements intended for coaxial cable installation. Check raceways, cables, trays, and other elements for compliance with accessibility for installation and maintenance, and other conditions affecting installation.

B. Examine walls, floors, roofs, equipment bases, and roof supports for suitable conditions where television equipment is to be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 GENERAL REQUIREMENTS

A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, casework, and in accessible ceiling spaces. Conceal raceway and cables except in unfinished spaces.
    1. Install plenum cable in environmental air spaces, including plenum ceilings.
    2. Install cables concealed in accessible ceilings, walls, and floors wherever possible.

B. Supporting Cables: All cabling supports installed on this project shall be installed in a manner that results in all cabling being routed parallel and/or perpendicular with adjacent building lines (walls, floors, and structural elements). Cables flown above ceilings diagonally or angles other than 90-degrees or 0-degrees relative to adjacent building lines will not be accepted. Non-compliant installations shall be removed and reinstalled at the expense of this contractor. Do not run adjacent and parallel to power or data cables.

C. Cable and wiring shall not lay loose on ceiling tiles or grids.

D. Wiring within enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

E. Support cables with Velcro straps. Vinyl cable ties are prohibited.

F. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturers published torque tightening values for equipment connectors. Where manufacturer's torque tightening requirements are not indicated, tighten connectors and terminals to comply with tightening torques per NEC specifications.

G. Grounding: According to recommendations in IEEE 142 and IEEE 1100.
H. Install coaxial cables in telecommunications cable trays where permissible; place coaxial cables separated away from voice and data cabling. When coaxial cables are not support in cable tray or conduit, provide a separate J-hook support system.
I. Follow manufacturer's installation instructions for the installation of coaxial cable. Trunk cable shall not bend of 20 times the cable diameter (approximately 11-inch maximum bend radius).
J. Terminate RG-6 cables at TV outlet locations with F-connectors and connected to faceplate feed-through couplers installed in faceplates.
K. Connect all coaxial cable on couplers, splitter, and amplifiers so the coaxial cabling system is ready to distribute input signals with clear images at all TV outlet locations in the building.
L. TV outlet locations shall be clearly labeled and identified on the as-built drawings.
M. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps may not be used for heating.
N. Cable may not be installed in same raceway with power cable.
O. Coaxial cable shall not be spliced except on plywood backboards in wire closets or in cabinets designated for the purpose.
P. Do not use water-based cable pulling lubricants with PVC-jacketed cable.
Q. Do not exceed manufacturer's recommended minimum bending radiuses.
R. Pulling Cable: Do not exceed manufacturer's recommended pulling tensions. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
S. Cable Support: Install supports at intervals recommended in writing by cable manufacturer. Install supports within 6 inches (150 mm) of connector so no weight of cable is carried by connector. Use no staples or wire ties, pull tie-wrap snug, and do not over tighten.
T. Signal Equalization: Where system performance may be degraded in certain operating modes, revise component connections and install distribution amplifiers and attenuators as required, providing a balanced signal across the system.
U. Install passive circuit devices, such as splitters and attenuators, in wire closets or cabinets. Do not install attenuators as part of user-interface device outlets.
V. Provide a 75ohm terminator cap at every jack. Tighten each with a wrench until snug.

3.03 MDF AND FACILITY WIDE RF SYSTEM

A. Provide taps/splitters/attenuators/amplifiers in all locations shown on Technology Prints. (NOTE: Drawing is a basic guide based off of estimated distances. Actual distances depend on cable pathways and other variables. Results could vary and minor changes of tap/splitters/amplifiers/attenuators may need to take place. Please take this into consideration. Find best suitable technician with broad range of knowledge on RF distribution to complete work and before all hardware is purchased. Any changes to drawing will first need to be consulted with Life Time AV representative representative).
    1. All splitters/taps shall be anchored to a solid surface using anchors/zip ties or other means. No Splitter/tap/attenuator shall be visible.
    2. Soffit TV taps shall be installed on soffit shelf adjacent to each TV.
    3. Tighten all F connectors with wrench until snug.
B. In MDF: Install all Splitters/Amplifiers on Wall behind Video Rack(s).
    1. Provide custom made, short black RG6 quad jumpers terminated with F connectors for the interconnects between all pieces on wall behind video rack. Jumpers are no less than 12" long.
    2. All cables shall be secured to wall in a neat and workmanlike manor.
    3. All open ports on splitters shall be capped with 75ohm terminator cap. Provide caps as necessary.
    4. All splitters/amplifiers shall be grounded. See drawing for more information.

5. Provide proper minimum #16 solid grounding cable and termination hardware. See Section 27 05 26 for more grounding information.
6. Provide secondary grounding bus for splitters/amplifiers.
7. Ground secondary bus to main copper ground bus in MDF. Provide proper grounding hardware.

C. For each TV coax jack (F connector) installed in entire facility:
1. Provide a custom made 10 foot black RG6 quad jumper with terminated with F connectors on both ends. Test each cable to rule out any shorts/opens in cable.
a. Box up and give to AV installation vendor.
b. Jumpers will be installed by AV vendor.

3.04 MAIN WORKOUT FLOOR

A. Overhead Soffit TVs:
1. Cat5e: (1 termination per TV)
a. Terminate to female cat5e jack in wallplate.
b. All ceiling wiring must be tied to deck.
2. RF: (1 termination per TV)
a. Design RF System design based on layout on prints.
b. Install RG6/RG11 quad shielded cabling.
c. Terminate with F-Connectors and provide wall plates.
d. Provide RG6 “patch cables” at each wall plate for connection to cardio equipment. Lengths will vary per piece of equipment.
e. All ceiling wiring must be tied to deck.

B. Workout Floor cardio equipment TVs in floor boxes
1. RF: (1 termination per floor box)
a. Design/Provide RF System design based on layout on prints.
b. Install RG6/RG11 quad shielded cabling.
c. Terminate with F-Connectors.
d. Provide RG6 “patch cables” at each floor plate for connection to cardio equipment. Lengths will vary per piece of equipment.

3.05 HEAD-END INSTALLATION

A. Mount head-end equipment in electronic equipment cabinets recommended by manufacturer. Group related items in methodical sequence.

B. Arrange equipment to facilitate access for maintenance and to preserve headroom and passage space. Parts that require periodic service or maintenance shall be readily accessible. Head-end components that require tuning adjustments shall be accessible from the front of equipment cabinets.

C. Cable Entrance: Use entrance fittings, seal, and waterproof penetrations of the building envelope.

D. Provide a #6 AWG insulated ground wire from the main equipment rack to the ground bus located in the room.

3.06 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals according to Division 26 Section "Identification for Electrical Systems."

B. Identify and tag all cables with permanent type markers to denote location served.
1. Label each coax feed with the zone number associated, location, and calculated line loss. Use professional label, black on white. See section 270553 for labels for communications system.
2. Label input/output of each Splitter with input signal dB and output signal dB.
3. Label input/output of each Amplifier with input signal dB and what output signal dB is set to.
4. Label each tap to correspond with floor box location on Technology Drawing, i.e. C1-01, C1-02 etc.

C. Each major system component shall be labeled as to function and area served.

D. All front panel controls used in the normal operation of the system shall be clearly labeled using plastic laminate engraved labels or approved equal. Labels shall be firmly affixed to the panel or device. Dymo or Kroy tape adhesive backed lettering is not acceptable.

3.07 FIELD QUALITY CONTROL

A. Inspection: Verify that units and controls are properly installed, connected, and labeled, and that interconnecting wires and terminals are identified.

B. Pretesting: Align and adjust system and pretest components, wiring, and functions to verify that they comply with specified requirements. Replace malfunctioning or damaged items. Retest until satisfactory performance and conditions are achieved. Prepare television equipment for acceptance and operational testing as follows:
   1. Use an agile receiver and signal strength meter or spectrum analyzer for testing.
   2. Off-Air, Mast-Mounted Antenna Sources: Connect receiver to the down lead of a 10-element, single-channel antenna, tuned and oriented to optimize reception for the channel and placed at system antenna's location. Alternatively, connect receiver to a single-channel video amplifier connected to the down lead of the above single-channel antenna.
   3. CATV Sources: Connect receiver to an agile demodulator or CATV set-top converter at CATV service entrance to the facility.

C. Final Acceptance Testing Schedule: Schedule tests after pretesting has successfully been completed and system has been in normal functional operation for at least 14 days. Provide notice of test schedule a minimum of 10 days prior to testing.

D. Operational Tests: Perform operational system tests to verify that system complies with Specifications. Include all modes of system operation. Test equipment for proper operation in all functional modes.

E. Send test signal and test each TV location, using Digital and Analog RF tester.
   1. Test signal from main feed to each drop. See drawing for more information.
      a. If signal is not present at time of balancing, generate a test signal of 28dB to match output of video rack.
   2. Adjust amplifiers if attenuation is necessary. Before adjustment, contact/discuss with Life Time AV representative before any changes occur.
   3. Measure each jack, at each TV location in entire facility, and ensure it reads between +0dB and +5dBmV. Provide digital RF meter for tests.
   4. If adjustment is needed, install correct taps and/or attenuators at each piece to accommodate the proper signal level. Contact/discuss with Life Time AV representative before any changes occur.
   5. Provide Microsoft Excel form and/or print out stating measured dB at each TV jack for certification. Turn over documentation to Life Time AV representative upon completion for signoff. Form shall include:
      a. Each Homerun Distance.
      b. Each Homerun dB loss.
      c. Number and final dB reading of each tap, attenuator, and/or splitter in run
      d. Measurement of each splitter/amplifier in MDF.

F. Distribution System Acceptance Tests:
   1. Field-Strength Instrument: Rated for minus 40-dBmV measuring sensitivity and a frequency range of 54 to 1000 MHz, minimum. Provide documentation of recent calibration agains recognized standards.
   2. Signal Level and Picture Quality: Use a field-strength meter or spectrum analyzer, and a standard TV receiver to measure signal levels and check picture quality at random sampling of 25 percent of outlets. User-interface outlets.
      a. Test the signal strength in dBmV at 55, 151, 547, and 750 and 1000 MHz.

b. Minimum acceptable signal level is 0 dBmV (1000 mV).
c. Maximum acceptable signal level over the entire bandwidth is 15 dBmV.
d. Television receiver shall show no evidence of cross-channel intermodulation, ghost images, or beat interference.

3. Signal-to-Noise-Ratio Test: Use a field-strength meter to make a sequence of measurements at the output of the last distribution amplifier or of another agreed-on location in system. With system operating at normal levels, tune meter to the picture carrier frequency of each of the designated channels in turn and record the level. With signal removed and input to corresponding head-end amplifier terminated at 75 ohms, measure the level of noise at same tuning settings. With meter correction factor added to last readings, differences from first set must not be less than 45 dB.

G. Qualitative and Quantitative Performance Tests: Demonstrate reception quality of color-television program transmissions at each user interface from each designated channel and source. Quality shall be equal to or superior than that obtained with performance checks specified below, using a standard, commercial, cable-ready, color-television receiver. Level and quality of signal at each outlet and from each designated channel and source shall comply with the following Specifications when tested according to 47 CFR 76:
1. RF video-carrier level.
2. Relative video-carrier level.
3. Carrier level stability, 60-minute and 24-hour periods.
4. Broadband frequency response.
5. Channel frequency response.
6. Carrier-to-noise ratio.
7. RF visual signal-to-noise ratio.
8. Cross modulation.
9. Carrier-to-echo ratio.
10. Composite triple beat.
11. Second order beat
12. Terminal isolation.
13. Terminal isolation between television and FM.
14. Hum modulation.
15. RF FM carrier level.
16. FM frequency response.
17. FM carrier-to-noise ratio.

H. Record test results.

I. Retest: Correct deficiencies identified by tests and observations and retest until requirements specified in Part 1 are met.

J. After certification:
1. Create “As-Built” drawings of the final RF design, stating length, db loss, etc., of entire facility on a separate set of Technology sheets. Leave a copy Stapled to the wall in the MDF and also send a copy of to the Life Time AV representative upon completion.

END OF SECTION

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SECTION 28 08 00
COMMISSIONING OF SAFETY AND SECURITY SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. This section includes specific requirements that apply to the implementation of the Commissioning Process and this Division Contractors' participation in this process. This section details the project specific equipment and systems that are included in the Commissioning Process. For general descriptions and responsibilities, refer to SECTION 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

1.02 RELATED DOCUMENTS

A. The Owner's Project Requirements (OPR) document.

B. The Basis of Design (BoD) document.

C. The Project Commissioning Plan (CxP) document.

D. ASHRAE Standard 202-2013 - Commissioning Process for Buildings and Systems.

E. LEED v4 for Building Design and Construction.

1.03 RELATED SECTIONS

A. SECTION 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS

B. SECTION 07 08 00 - COMMISSIONING OF THERMAL AND MOISTURE PROTECTION

C. SECTION 08 08 00 - COMMISSIONING OF OPENINGS

D. SECTION 11 08 00 - COMMISSIONING OF EQUIPMENT

E. SECTION 13 08 00 - COMMISSIONING OF SPECIAL CONSTRUCTION

F. SECTION 14 08 00 - COMMISSIONING OF CONVEYING SYSTEMS

G. SECTION 21 08 00 - COMMISSIONING OF FIRE SUPPRESSION SYSTEMS

H. SECTION 22 08 00 - COMMISSIONING OF PLUMBING SYSTEMS

I. SECTION 23 08 00 - COMMISSIONING OF MECHANICAL SYSTEMS

J. SECTION 25 08 00 - COMMISSIONING OF INTEGRATED AUTOMATION SYSTEMS

K. SECTION 26 08 00 - COMMISSIONING OF ELECTRICAL SYSTEMS

L. SECTION 27 08 00 - COMMISSIONING OF COMMUNICATIONS SYSTEMS

M. SECTION 33 08 00 - COMMISSIONING OF UTILITIES

1.04 DEFINITIONS

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

1.05 RESPONSIBILITIES

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

PART 2 PRODUCTS

2.01 NO PRODUCTS SUPPLIED

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

B. Contractors and/or Vendors shall provide the specialty testing equipment necessary to fulfill the functional testing requirements, for the duration of the testing period.

PART 3 EXECUTION

3.01 GENERAL

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.02 MEETINGS

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.03 SYSTEM START-UP

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.04 PRE-FUNCTIONAL CHECKLISTS

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.05 FUNCTIONAL PERFORMANCE TESTING

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.06 TRAINING

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.07 SYSTEMS TO BE COMMISSIONED

A. GENERAL
   1. Commissioning specifications supplement the requirements of individual specifications sections, but shall not be interpreted to replace or diminish the specified scope of any individual section.
   2. For all systems listed below, Division Contractor shall comply with all commissioning requirements specified.

B. APPLICABLE SYSTEMS
   1. Identification for Security Systems
   2. Electronic Access Systems
   3. Digital Addressable Fire Alarm System
   4. Distributed Antenna System

END OF SECTION

SECTION 28 10 04
ACCESS CONTROL DEVICES AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Intelligent controllers with licenses.
B. Access control cabinets and power supplies.
C. Card readers.
D. Request-to-exit sensors.
E. Door contacts
F. Key cabinets.
G. Cable terminations.

1.02 RELATED REQUIREMENTS

A. The Drawings, the provisions of the Contract, including General and Supplementary Conditions, and the General Requirements apply to the Work of this Section.
B. Section 08 71 00 Door Hardware.
    1. Review all electric locks, strikes and panic bars.
C. Division 26 – All Sections.
D. Division 27 – All Sections.
E. Division 28 – All Sections.

1.03 DEFINITIONS

A. Access Control Device and Equipment Contractor (ADEC) – The contractor performing the scope of work described in this section.
B. Access Control System Integrator (ACSI) – The owner's current access control system integrator.
    1. Contact:
        Affinitech, Inc
        1264 Park Rd,
        Chanhassen, MN 55317
        +1 (952) 697-2100
        info@affinitechinc.com

1.04 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements listed below.
B. The ADEC shall meet the following requirements:
    1. Open Options Essentials Certification.
    2. Project Experience
        a. Three (3) years experience in the access control field of commercial, institutional and/or industrial facilities (non-residential).
    3. Minimum Staff Qualifications
        a. Must have the necessary trained, licensed, and bonded trade and technical persons necessary to perform the tasks required under this specification.
        b. Licensed as Power Limited Technicians through the Minnesota State Board of Electricity and have successfully completed an accredited, industry related, electronics course.
        c. In-house personnel to maintain and submit electronic record documentation in the most current AutoCAD and Microsoft Excel format.
    4. References and Qualification Submittal
        a. Project references and qualification submittals shall be provided upon request.

1.05 SUBMITTALS

A. Submit per the General Requirements of the project specifications.

B. Shop Drawings:
   1. Submit to the engineer all data sheets for components. The parts list and the corresponding data sheets shall be submitted in the same order in a single PDF file. Multiple PDF files will be rejected.
   2. A system riser with typical wiring diagram for devices and cabinets
C. Project Coordination Documents:
   1. ADEC Excel Spreadsheet
      a. Provide a Microsoft Excel Spreadsheet listing the controllers with associated boards and devices.
      b. The spreadsheet shall identify:
         1) Install date
         2) Controller numbers
         3) Model
         4) IP address
         5) MAC address
         6) Door numbers
         7) Device termination
         8) Device model number

1.06 DELIVERY, STORAGE, AND HANDLING

A. Package, handle, deliver and store at the job site in a manner that will avoid damage.
B. Provide locked storage units.
C. Contractor shall not deliver, store, or install any product in construction areas where the product is subject to damage from water, dust, and construction debris.

1.07 WARRANTY

A. Provide warranty per the general and supplemental conditions of the contract.

PART 2 PRODUCTS

2.01 SUBSTITIUTIONS

A. Unless noted as “Or Approved Equal” the approved products are standard products in use throughout the owner’s facilities. No substitutions are allowed. If a listed product cannot be provided, notify the engineer in writing prior to the final addendum date and an alternative product will be identified.
B. Where noted as “Or Approved Equal” submit requests per the general terms and conditions of the contract.
C. Approved equals must meet or exceed all manufacturer’s specifications for the listed product. Any exceptions must be approved by the design engineer.
D. Approved equals will only be considered when submitted by a qualified ADEC. Requests from product manufacturers or their representatives will not be considered.

2.02 APPROVED PRODUCTS

A. Intelligent controller module for member management system
   1. Minimum requirements:
      a. Mercury hardware
      b. 96 MB available memory
      c. 2,000,000 card holder capacity
      d. Support 64 total doors with 2 on-board
      e. Open Option license
   2. Approved products:
      a. Open Options LP4502 (SSP-LX)
B. Intelligent controller module for staff management system
   1. Minimum requirements:

a. Mercury hardware

b. 6 MB available memory
c. 240,000 card holder capacity
d. Support (17) total doors with (1) on-board
e. Open Option license

2. Approved products:
a. Open Options DController (LP1501)

C. 4 door power supply and cabinet for control modules
1. Minimum requirements:
a. FPO offline power supply
1) 120 or 230 VAC input
2) 12 and 24 VDC outputs
3) Continuous and resettable DC
b. Distributed outputs
1) 8 auxiliary
2) 4 controlled
3) PTC option
c. Lifetime Warranty
2. Approved products:
a. Lifesafety Power Supply #LSP-4DR-E4M
b. Or approved equal.

D. Card reader/keypad
1. Minimum requirements:
a. Dimensions: 80 mm x 121.5 mm x 19.5 mm (3.15 in x 4.78 in x 0.77 in)
b. MHz contactless smart cards supported: Seos®, iCLASS SE, iCLASS®, MIFARE DESFire®EV1/EV2 and MIFARE® Classic.
c. 125 kHz contactless cards supported: HID Prox®, Indala® Prox, Dorado® Prox, and EM Prox legacy contactless credentials
d. Protocol: Wiegand
2. Approved products:
a. HID 40KNKS-00-000000

E. Request-to-exit sensor
1. Minimum requirements:
a. Ceiling mount
b. PIR sensor
2. Approved products:
a. Bosch DS-160
b. Or approved equal.

F. Door contact – recessed
1. Minimum requirements:
a. Recess mount
b. Match color to frame
c. DPDT contact arrangement
2. Approved products:
a. GE Sentrol 1076D
b. Or approved equal.

G. Key cabinet
1. Minimum requirements:
a. Manage a minimum of 5 sets of keys

b. Wall mount
c. Ethernet (TCP/IP) 10/100MB communications
d. Reader interface: Clock/ data, Wiegand, Serial (RS232/TTL), Pin only, OSDP Readers (RS485) with or without encryption
e. Alarm interface: 3x1A/24V dry contact relay contacts

2. Approved products:
a. Traka Touch Pro V

PART 3 EXECUTION

3.01 PHASING REQUIREMENTS

A. Refer to the architectural phasing plans. Provide all scope of work per the phasing plans.

3.02 INSTALLATION AND OPERATIONAL REQUIREMENTS

A. Access control cabinets
1. Mount the Access Control Cabinets for both the Member Management System and the Staff Management System where shown on plans.
2. Coordinate mounting location of power supplies / cabinets and 120V connection requirements with electrical contractor.
3. ACSI shall identify which doors that are terminated on the Member Management System and the Staff Management System. Coordinate prior to cabling termination in the cabinet.

B. Device cabling
1. Composite device cabling (Belden 658AFJ) is provided by Division 27 15 00 Communications Horizontal Cabling Contractor. Cabling will be installed from the panel location to the ceiling space of the door.
2. Coordinate the location of the device cabling in the ceiling from the cabling contractor and complete routing of the cabling through conduit and frame to device locations.
3. Provide final termination of device cabling to card reader, electric lock, door contact and request-to-exit sensor.
4. Provide final termination of device cabling to the control modules and power supplies. Maintain a 10’ service loop where the cable enters the cabinet.
5. Provide permanent label to each end of the device cable with the device number.

C. Card readers
1. Coordinate final reader location with electrical contractor prior to electrical rough in.
2. Provide device cabling to the Access Control Panel identified by the Access Control System Integrator.
3. Coordinate testing of the card reader operation with the Access Control System Integrator such that the reader is tested at the time of installation.

D. Door contacts
1. Provide supervised inputs with end of line resistors at the contact. Do not place end of line resistors at the panel location.

E. Request-to-exit sensors
1. Locate and adjust the sensor to detect person(s) as they contact the exiting door hardware.
2. Adjust as required to minimize false alarms.
3. Adjust timers per recommendations from the Access Control System manufacturer.

F. Electric lock
1. Electric lock provided by Division 08 71 00 Door Hardware Contractor.
2. Coordinate connection requirements and lock voltage with Hardware Contractor.
3. Provide cable routing through frame, hinge/transfer, and final cable termination.

G. Key cabinets
1. Mount the key cabinets where shown on plans.

2. Coordinate mounting location of power supplies / cabinets and 120V connection requirements with electrical contractor.
3. Coordinate the network jack, patch panel, and TR room number for the key cabinet with the Division 27 15 00 Communications Horizontal Cabling Contractor.

H. Labeling
1. All labels shall be machine printed white background black letter labels with permanent ink and permanent adhesive.
2. Handwritten labels are not acceptable at any locations.
3. All equipment, cabinets, and junction boxes shall be labeled to match the designators shown on a corresponding as-built riser wiring diagram.
4. Each cable shall be labeled at all terminations points to match a corresponding as-built wiring diagram. Labeling is not required for interconnections within an enclosure or assembly.
5. Submit a labeling plan to the owner prior to label installation.

3.03 CLOSEOUT ACTIVITIES

A. Provide testing and close out per each phase as shown in the architectural phasing plan.
B. System testing
1. Testing shall be a coordinated effort between the ACSI, and the ADCE. Each contractor shall provide technicians to fully test each door.
a. ADCE – Provide a technician at the door.
b. ACSI– Provide a technician at the head end and provide either a laptop or connection to a workstation to facilitate testing.

C. Each door shall be tested in sequential order and a corresponding written test report shall be submitted to the engineer. Test each door and each of the following conditions in this order:
1. System Testing - Test each door and each of the following conditions in this order:
a. Normal card read – No alarms.
b. Normal egress – No alarms, adjust RTE sensors to eliminate false alarms.
c. Prop door – workstation alarm.
d. Forced door – workstation alarm.

D. Conduct a final acceptance test with the Owner and ACSI after system testing is complete, test reports have been submitted, and as built documentation has been submitted.
1. Upon completion of the above items and all requirements identified in the plans and specifications:
a. Notify the engineer in writing and request final acceptance.
b. Conduct an on-site demonstration to the engineer of system performance and compliance with the plans and specifications.
c. Correct any items noted by the engineer during acceptance and submit a signed punch list of corrections made..

E. Submit project closeout documentation.
1. Final ADEC Excel Spreadsheet
2. As-built plans in AutoCAD format.
a. As-builts shall include floorplans showing symbols for all devices, access control panel locations, and power supply locations.
b. Riser diagrams showing interconnection of all devices and controller locations.
c. Elevations of access control cabinets and powers supplies.

3. Operator and Maintenance Manuals shall be submitted as electronic documents or media. Hardcopy shall only be submitted if electronic versions are not available.

F. Issue a statement of warranty to the Owner and copy the Engineer.

END OF SECTION

SECTION 28 21 00
VIDEO SURVEILLANCE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Interior directional cameras.
B. Interior panoramic cameras.

C. Indoor environmental rated camera.
D. Exterior directional camera.
E. Patch cables.
F. Corporate camera licenses.

1.02 RELATED REQUIREMENTS

A. Section 07 84 00 - Firestopping.
B. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
C. Section 26 05 29 - Hangers and Supports for Electrical Systems.
D. Section 26 05 34 - Conduit for Electrical Systems.
E. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
F. Division 27 - All sections.

1.03 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.
B. NECA 303 - Standard for Installing Closed-Circuit Television (CCTV) Systems; National Electrical Contractors Association; 2005.
C. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 DEFINITIONS

A. Video Surveillance Camera Contractor (VSCC) – The contractor performing the scope of work described in this section.
B. Video Management System Integrator (VMSI) – The owner's current video system integrator.
    1. Contact:
        Affinitech, Inc
        1264 Park Rd,
        Chanhassen, MN 55317
        +1 (952) 697-2100
        info@affinitechinc.com

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
    1. Coordinate the placement of cameras with structural members, ductwork, piping, equipment, luminaires, diffusers, fire suppression system components, and other potential conflicts installed under other sections or by others.
    2. Coordinate the work with other installers to provide power for cameras and equipment at required locations.
    3. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.06 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings

Submit to the engineer all data sheets for components. The parts list and the corresponding data sheets shall be submitted in the same order in a single PDF file. Multiple PDF files will berejected.

C. Project Coordination Documents
   1. VSCC Excel Spreadsheet
      a. Provide a Microsoft Excel Spreadsheet listing the cameras in sequential order as shown on floorplans.
      b. The VSCC spreadsheet shall identify:
         1) Install Date
         2) Device Number
         3) Floor
         4) Model
         5) Mount
         6) Firmware
         7) Serial Number
         8) MAC Address
         9) Patch Panel Termination
         10) IP Address

1.07 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements listed below.

B. Comply with the following:
   1. NFPA 70
   2. Applicable TIA/EIA standards.

C. The VSCC shall meet the following requirements:
   1. Axis certified professional.
   2. Project experience:
      a. Five (5) years experience in installation of IP camera systems.
      b. Five (5) projects exceeding (50) cameras within the last (5) years.
   3. Minimium staff qualifications:
      a. Must have the necessary trained, licensed, and bonded trade and technical persons necessary to perform the tasks required under this specification.
      b. Licensed as Power Limited Technicians through the Minnesota State Board of Electricity and have successfully completed an accredited, industry related, electronics course.
      c. Two (2) persons assigned to the project that have completed the Axis Certification Program and are directly responsible for:
         1) Camera configuration.
         2) On-site camera installation.
         3) As-built documentation.
      d. In-house personnel to maintain and submit electronic record documentation in the most current AutoCAD and Microsoft Excel format.
   4. References and qualification submittal.
      a. Project references and qualification submittals shall be provided upon request.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions and NECA 303.

B. Store products in manufacturer's unopened packaging, keep dry and protect from damage until ready for installation.

C. Provide locked storage units.

D. Contractor shall not install any product in construction areas where the product is subject to damage from water, dust, and construction debris.

1.09 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.10 WARRANTY

A. Provide warranty per the general and supplemental conditions of the project.

PART 2 PRODUCTS

2.01 SUBSTITUTIONS

A. Unless noted as “Or Approved Equal” the approved products are standard products in use throughout the owner’s facilities. No substitutions are allowed. If a listed product cannot be provided, notify the engineer in writing prior to the final addendum date and an alternative product will be identified.

B. Where noted as “Or Approved Equal” submit requests per the general terms and conditions of the contract.

C. Approved equals must meet or exceed all manufacturer’s specifications for the listed product. Any exceptions must be approved by the design engineer.

D. Approved equals will only be considered when submitted by a qualified VSCC. Requests from product manufacturers or their representatives will not be considered.

2.02 APPROVED PRODUCT

A. Interior directional camera
   1. Minimum Requirements
      a. Overview
         1) Resolution: 2MP.
         2) Zipstream.
         3) Lens: Varifocal, 3.4–8.9 mm, F1.8.
         4) WDR: Forensic Capture.
         5) Axis’ Lightfinder technology.
      b. Video Compression
         1) H.264 (MPEG-4 Part 10/AVC) Baseline, Main, and High Profiles H.265 (MPEG-H Part 2/HEVC) Main Profile Motion JPEG.
      c. Video Streaming
         1) Multiple, individually configurable streams in H.264, H.265, and Motion JPEG Axis Zipstream technology in H.264 and H.265 controllable frame rate and bandwidth VBR/ABR/MBR H.264/H.265 low latency mode video streaming indicator.
      d. Power
         1) Power over Ethernet (PoE) IEEE 802.3af/802.3at Type 1 Class 2 Typical 3 W, max 5.1 W.
      e. Mount
         1) Provide mounts as shown on plan, schedule, and/or required for proper installation of a complete system.
   2. Approved products:
      a. Camera type Axis P3265-V.

B. Interior panoramic camera
   1. Minimum Requirements:
      a. Overview
         1) Resolution: 6MP.
         2) Zipstream.
         3) Lens: 1.6 mm, F2.0.
         4) WDR: Forensic Capture.
         5) Axis’ Lightfinder technology.
      b. Video Compression

1) H.264 (MPEG-4 Part 10/AVC) Baseline, Main, and High Profiles H.265 (MPEG-H Part 2/HEVC) Main Profile Motion JPEG.

c. Video Streaming

1) Multiple, individually configurable streams in H.264, H.265, and Motion JPEG Axis Zipstream technology in H.264 and H.265 Controllable frame rate and bandwidth VBR/ABR/MBR H.264/H.265 Low latency mode Video streaming indicator.

d. Power

1) Power over Ethernet (PoE) IEEE 802.3af/802.3at Type 1 Class 2 Typical 3.7 W, max 6.49 W.

e. Mount

1) Provide mounts as shown on plan, schedule, and/or required for proper installation of a complete system.

2. Approved products:

a. Camera type Axis M3067-P.

C. Indoor environmental rated camera

1. Minimum Requirements:

a. Overview

1) Resolution: 2MP.
2) Zipstream.
3) Lens: Varifocal, 3.4–8.9 mm, F1.8
4) WDR: Forensic Capture.
5) Axis' Lightfinder technology.

b. Video Compression

1) H.264 (MPEG-4 Part 10/AVC) Baseline, Main, and High Profiles H.265 (MPEG-H Part 2/HEVC) Main Profile Motion JPEG.

c. Video Streaming

1) Multiple, individually configurable streams in H.264, H.265, and Motion JPEG Axis Zipstream technology in H.264 and H.265 Controllable frame rate and bandwidth VBR/ABR/MBR H.264/H.265 Low latency mode Video streaming indicator.

d. Power

1) Power over Ethernet (PoE) IEEE 802.3af/802.3at Type 1 Class 2 Typical 4.8 W, max 10.7 W.

e. Mount

1) Provide mounts as shown on plan, schedule, and/or required for proper installation of a complete system.

2. Approved products:

a. Camera type Axis P3265-LVE.

D. Exterior directional camera

1. Minimum Requirements:

a. Overview

1) Resolution: 8MP.
2) Zipstream.
3) Lens: Varifocal, 6.2–12.9 mm, F1.6–2.9.
4) WDR: Forensic Capture.
5) Axis' Lightfinder technology.

b. Video Compression

1) H.264 (MPEG-4 Part 10/AVC) Baseline, Main, and High Profiles H.265 (MPEG-H Part 2/HEVC) Main Profile Motion JPEG.

c. Video Streaming

2.

1) Multiple, individually configurable streams in H.264, H.265, and Motion JPEG Axis Zipstream technology in H.264 and H.265 Controllable frame rate and

bandwidth VBR/ABR/MBR H.264/H.265 Low latency mode Video streaming indicator.

b. Power
   1) Power over Ethernet (PoE) IEEE 802.3at Type 2 Class 4 Typical 9 W, max 23 W 10–28 V DC, typical 9 W, max 24 W.

c. Mount
   1) Provide mounts as shown on plan, schedule, and/or required for proper installation of a complete system.

d. Powder coating
   1) Provide powder coating of camera body. Color code furnished by architect.

3. Approved products:
   a. Camera type Axis Q3538-LVE with custom powder coating.

E. Patch cables
1. Minimum requirements:
   a. Provide patch cabling from device jack to camera.
   b. Provide patch cabling from the patch panel to network switch.
   c. 7’ length typical, unless noted otherwise.
   d. Stranded cabling.
   e. Booted.
   f. Plenum rated.
   g. Meet or exceed Cat6 TIA/EI-568-B2.1.
   h. Blue jacket.
2. Approved products:
   a. Systimax.
   b. Panduit.
   c. Leviton.
   d. Or approved equals.

F. Corporate camera licenses
1. Approved products:
   a. Milestone XProtect corporate license.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.
B. Verify that ratings and configurations of system components are consistent with the indicated requirements.
C. Verify that mounting surfaces are ready to receive system components.
D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to system.
E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PHASING

A. Phasing and scheduling.
1. Complete all work in accordance with the architectural project phasing plans and specifications.

3.03 INSTALLATION AND OPERATIONAL REQUIREMENTS

A. Material and workmanship shall comply with applicable codes. As a minimum, codes include all state and federal laws, local ordinances and interpretations of the following by the local Authority Having Jurisdiction (AHJ).
B. Install video surveillance system in accordance with NECA 1 (general workmanship) and NECA 303.
C. Comply with all OSHA requirements.

D. Camera configuration and pretest
    1. Prior to installation, connect the camera to a test PC and POE network switch (contractor owned).
        a. Upgrade the camera firmware to the most recent available firmware approved by the VMSI.
        b. Configure the default password as directed by the VMSI.
        c. Configure the default IP Address as directed by the VMSI.
        d. Test the following applicable functions:
            1) Motorized or manual focus.
            2) IR illumination.
            3) Inspect the image for clarity and color reproduction.
            4) Inspect the camera door for scratches or other visual deficiencies.
            5) Inspect the camera housing for scratches, cracks, or other deficiencies.
    2. Receive the network jack, patch panel, and TR room number for each camera from the Division 27 15 00 Communications Horizontal Cabling Contractor.
    3. Provide a permanent label to the rear of the camera body denoting the camera number.
        a. Black lettering on clear backing, 0.125” W.
    4. Log all resulting configuration information in the VSCC spreadsheet and submit to the VMSI for approval prior to camera installation.
E. Camera installation
    1. Follow instructions in the installation documentation provided by the camera manufacturer.
    2. All equipment shall be tested and configured in accordance with instructions provided by the manufacturer prior to installation.
    3. Refer to camera details and schedules for mounting and accessory requirements.
    4. Seal exterior camera raceways and penetrations to prevent water infiltration to the building and camera enclosure.
    5. Field of View coordination.
        a. Prior to the installation of any cameras, the contractor shall review each location and view with the VMSI.
        b. Locate the camera to best provide the intended field of view. Where placement adjustments are required, locate the camera to provide a larger area of view than shown on plans. Notify the VMSI of any issues prior to installation.
        c. Do not install cameras in any location where the field of view is blocked by signage or any other visual obstruction. It is the contractor’s responsibility to notify the owner of any locations that should be changed to provide the intended field of view.
    6. Once installed, provide a final cleaning of the camera assembly. Ensure that domes or viewing window are free of dirt, dust, and fingerprints.
    7. Focus the camera per manufacture instructions.
    8. Turn on WDR for any cameras where light differentials may cause silhouetting of the foreground image. Typical locations include:
        a. Perimeter vestibules and perimeter doors.
        b. Loading dock doors.
        c. Skyways.
        d. Window lined corridors.
        e. Rooms with exterior windows.
    9. Test images.
        a. Capture a test image of each camera in full resolution. Name the image filename to match the camera number.
        b. Submit a test image of each camera view to the VMSI.
F. Raceway and patch cabling from the camera to the data jack.

1. Coordinate final camera locations with the Division 27 15 00 Communications Horizontal Cabling Contractor.
2. Provide patch cabling from the camera to the camera data jack.
3. Exposed patch cabling from the camera to the data jack is allowed in accessible ceiling spaces.
4. In interior exposed areas and exposed ceiling spaces, provide metallic wiremold or surface conduit from the camera to the data jack or accessible ceiling space.
5. For exterior cameras, provide flexible metallic sealtight conduit from the camera to the data jack or accessible ceiling.

G. Provide required support and attachment for each installed condition.
H. Provide grounding and bonding in accordance with Section 26 05 26.
I. Install firestopping to preserve fire resistance rating of partitions and other elements.
J. Identify system wiring and components.

3.04 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.05 CLOSEOUT ACTIVITIES

A. Acceptance Testing.
1. Schedule an acceptance test with the owner and VMSI after all record documentation is submitted for approval.
a. Provide on site demonstration of installed equipment.
b. Demonstrate device locations and cabling terminations.
2. A punch list of deficiencies will be generated by the engineer.
3. Make all required corrections and return a signed punch list stating that all repairs are complete.

B. Training: Train Owner's personnel on operation, adjustment, and maintenance of system.
1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
2. Provide minimum of four hours of training.
3. Location: At project site.

C. Submit: Project closeout documentation.
1. Final VSCC Microsoft Excel spreadsheet.
2. Final image file from each camera.
3. As-built floorplans in AutoCAD format showing:
a. Camera locations.
4. Warranty letter.
5. All close out documentation required by the general and supplemental conditions of the contract.

D. Warranty
1. Provide a 1-year parts and labor warranty. The warranty period shall commence with the completion of all punch list items.
2. Material Warrantees – Identify the material warranty period for all devices.
3. Submit all warranty information in a warranty letter to the owner. The warranty letter shall be signed by a company officer.

3.06 PROTECTION

A. Protect installed system components from subsequent construction operations.

END OF SECTION

SECTION 28 31 11
DIGITAL ADDRESSABLE FIRE ALARM SYSTEM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fire alarm system design and installation, including all components, wiring, and conduit.
B. Transmitters for communication with supervising station.
C. Maintenance of fire alarm system under contract for specified warranty period.

1.02 REFERENCE STANDARDS

A. IEEE C62.41.2 - Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits; 2002 (R2008).
B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
C. NFPA 72 - National Fire Alarm Code and Signaling Code ; 2018.
D. International Fire Code; 2018.

1.03 SUBMITTALS

A. See Division 1 sections for submittal procedures.
B. Drawings must be prepared using AutoCAD Release 2010 or newer.
   1. Engineer will provide electronic floor plan drawings for Contractor's use; verify all dimensions on provided drawings.
C. Design Documents: Submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, riser diagrams, and description of operation:
   1. Copy (if any) of list of data required by authority having jurisdiction.
   2. NFPA 72 "Record of Completion", filled out to the extent known at the time.
   3. Clear and concise description of operation, with input/output matrix similar to that shown in NFPA 72 Appendix A-7-5-2.2(9), and complete listing of software required.
   4. System zone boundaries and interfaces to fire safety systems.
   5. Location of all components, circuits, and raceways; mark components with identifiers used in control unit programming.
   6. Circuit layouts; number, size, and type of raceways and conductors; conduit fill calculations; spare capacity calculations; notification appliance circuit voltage drop calculations.
   7. List of all devices on each signaling line circuit, with spare capacity indicated.
   8. Manufacturer's detailed data sheet for each component, including wiring diagrams, installation instructions, and circuit length limitations.
   9. Description of power supplies; if secondary power is by battery include calculations demonstrating adequate battery power.
   10. Certification by either the manufacturer of the control unit or by the manufacturer of each other component that the components are compatible with the control unit.
   11. Certification by the manufacturer of the control unit that the system design complies with the contract documents.
   12. Certification by Contractor that the system design complies with the contract documents.
D. Evidence of installer qualifications.
E. Inspection and Test Reports:
   1. Submit inspection and test plan prior to closeout demonstration.
   2. Submit documentation of satisfactory inspections and tests.
   3. Submit NFPA 72 "Inspection and Test Form," filled out.
F. Operating and Maintenance Data: See Division 1 for additional requirements; revise and resubmit until acceptable; have one set available during closeout demonstration:
   1. Complete set of specified design documents, as approved by authority having jurisdiction.

2. Additional printed set of project record documents and closeout documents, bound or filed in same manuals.
3. Contact information for firm that will be providing contract maintenance and trouble call-back service.
4. List of recommended spare parts, tools, and instruments for testing.
5. Replacement parts list with current prices, and source of supply.
6. Detailed troubleshooting guide and large scale input/output matrix.
7. Preventive maintenance, inspection, and testing schedule complying with NFPA 72; provide printed copy and computer format acceptable to Owner.
8. Detailed but easy to read explanation of procedures to be taken by non-technical administrative personnel in the event of system trouble, when routine testing is being conducted, for fire drills, and when entering into contracts for remodeling.

G. Project Record Documents: See Division 1 for additional requirements; have one set available during closeout demonstration:
1. Complete set of floor plans showing actual installed locations of components, conduit, and zones.
2. "As installed" wiring and schematic diagrams, with final terminal identifications.
3. "As programmed" operating sequences, including control events by device, updated input/output chart, and voice messages by event.

H. Closeout Documents:
1. Certification by manufacturer that the system has been installed in compliance with his installation requirements, is complete, and is in satisfactory operating condition.
2. NFPA 72 "Record of Completion", filled out completely and signed by installer and authorized representative of authority having jurisdiction.
3. Certificate of Occupancy.

1.04 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements listed below.

B. Designer Qualifications: NICET Level III or IV (3 or 4) certified fire alarm technician or registered fire protection engineer, employed by fire alarm control panel manufacturer, Contractor, or installer , with experience designing fire alarm systems in the jurisdictional area of the authorities having jurisdiction.

C. Installer Qualifications: Firm with minimum 3 years documented experience installing fire alarm systems of the specified type and providing contract maintenance service as a regular part of their business.
1. Authorized representative of control unit manufacturer; submit manufacturer's certification that installer is authorized; include name and title of manufacturer's representative making certification.
2. Installer Personnel: At least 2 years of experience installing fire alarm systems.
3. Supervisor: NICET level III or IV (3 or 4) certified fire alarm technician; furnish name and address.
4. Certified in the State in which the Project is located as fire alarm installer.

D. Instructor Qualifications: Experienced in technical instruction, understanding fire alarm theory, and able to provide the required training; trained by fire alarm control unit manufacturer.

1.05 WARRANTY

A. See Division 1 Section Closeout Submittals, for additional warranty requirements.

B. Provide control panel manufacturer's warranty that system components other than wire and conduit are free from defects and will remain so for 1 year after date of Substantial Completion.

C. Provide installer's warranty that the installation is free from defects and will remain so for 1 year after date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Fire Alarm Control Units - Subject to compliance with requirements, provide products by the following:
   1. Silent Knight, by Honeywell.
   2. Fire Lite Alarms, by Honeywell.

B. Initiating Devices, and Notification Appliances:
   1. Same manufacturer as control units.
   2. Provide all initiating devices and notification appliances made by the same manufacturer.

C. Substitutions: As required by Authority Having Jurisdiction after review by owner, contact: Fire and Safety Systems Project Manager, 952-229-7273.

2.02 SEQUENCE OF OPERATIONS

A. Basic Alarm Performance Requirements: Unless otherwise indicated on the drawings, operation of a manual station, automatic alarm operation of a smoke or heat detector, or operation of a sprinkler flow device initiates the following:
   1. Indication of alarm condition at the FACP and the annunciator(s).
   2. Identification of the device or zone that is the source of the alarm at the FACP and the annunciator(s).
   3. Operation of audible and visible notification devices throughout the building until silenced at FACP.
   4. Unlocking designated doors.
   5. Shutting down supply and return fans that have duct smoke detectors.
   6. Closing smoke dampers on system serving zone where alarm is initiated.
   7. Notifying the local fire department.
   8. Initiation of elevator recall in accordance with ASME/ANSI A17.1, when specified detectors or sensors are activated.
   9. Shut down of audio reinforcement systems throughout building as indicated on the drawings.

B. Supervisory Operations: Upon activation of a supervisory device such as a tamper switch or carbon monoxide detector, the system shall operate as follows:
   1. Activate the system supervisory service audible signal and illuminate the LED at the control unit and the remote annunciator.
   2. Pressing the Supervisory Acknowledge Key will silence the supervisory audible signal while maintaining the Supervisory LED "on" indicating off-normal condition.
   3. Record the event in the FACP historical log.
   4. Transmission of supervisory signal to remote central station.
   5. Restoring the condition shall cause the Supervisory LED to clear and restore the system to normal.

C. Fire Suppression Monitoring:
   1. Water flow: Activation of a water flow switch shall initiate general alarm operations.
   2. Sprinkler valve tamper switch: The activation of any valve tamper switch shall activate system supervisory operations.
   3. WSO: Water flow switch and sprinkler valve tamper switch shall be capable of existing on the same initiating zone. Activation of either device shall distinctly report which device is in alarm on the initiating zone.

D. Required Functions: The following are required system functions and operating features:
   1. Priority of Signals: Fire alarm events have highest priority. Subsequent alarm events are queued in the order received and do not affect existing alarm conditions. Priority Two, Supervisory and Trouble events have second-, third-, and fourth-level priority respectively. Signals of a higher-level priority take precedence over signals of lower priority even though the lower-priority

condition occurred first. Annunciate all events regardless of priority or order received.

2. Non-interfering: An event on one zone does not prevent the receipt of signals from any other zone. All zones are manually resettable from the FACP after the initiating device or devices are restored to normal. The activation of an addressable device does not prevent the receipt of signals from subsequent addressable device activations.
3. Transmission to Remote Central Station: Automatically route alarm, supervisory, and trouble signals to a remote central station service transmitter provided under another contract.
4. Annunciation: Operation of alarm and supervisory initiating devices shall be annunciated at the FACP and the remote annunciator, indicating the location and type of device.
5. Alarm Silencing: If the "Alarm Silence" button is pressed, all audible (and visible alarm signals shall cease operation.
6. System Reset
    a. The "System Reset" button shall be used to return the system to its normal state. Display messages shall provide operator assurance of the sequential steps ("IN PROGRESS", "RESET COMPLETED") as they occur. The system shall verify all circuits or devices are restored prior to resetting the system to avoid the potential for re-alarming the system. The display message shall indicate "ALARM PRESENT, SYSTEM RESET ABORTED."
    b. Should an alarm condition continue, the system will remain in an alarmed state.
7. A manual evacuation (drill) switch shall be provided to operate the notification appliances without causing other control circuits to be activated.
8. WALKTEST: The system shall have the capacity of 8 programmable passcode protected one person testing groups, such that only a portion of the system need be disabled during testing. The actuation of the "enable one person test" program at the control unit shall activate the "One Person Testing" mode of the system as follows:
    a. The city circuit connection and any suppression release circuits shall be bypassed for the testing group.
    b. Control relay functions associated to one of the 8 testing groups shall be bypassed.
    c. The control unit shall indicate a trouble condition.
    d. The alarm activation of any initiation device in the testing group shall cause the audible notification appliances assigned only to that group to sound a code to identify the device or zone.
    e. The unit shall automatically reset itself after signaling is complete.
    f. Any opening of an initiating or notification appliance circuit wiring shall cause the audible signals to sound for 4 seconds indicating the trouble condition.

2.03 FIRE ALARM SYSTEM

A. General: Provide a complete, non-coded, addressable, microprocessor-based fire alarm system with initiating devices, notification appliances, and monitoring and control devices as indicated on the drawings and as specified herein.

B. Software: The fire alarm system shall allow for loading and editing instructions and operating sequences as necessary. The system shall be capable of on-site programming to accommodate system expansion and facilitate changes in operation. All software operations shall be stored in a non-volatile programmable memory within the fire alarm control unit. Loss of primary and secondary power shall not erase the instructions stored in memory. System shall be capable of storing dual configuration programs with one active and one in reserve. Panel shall be capable of full system operation during a new configuration download.

C. History Logs: The system shall provide a means to recall alarms and trouble conditions in chronological order for the purpose of recreating an event history. A separate alarm and trouble log shall be provided.

D. Recording of Events: Record all alarm, supervisory, and trouble events by means of system printer. The printout shall include the type of signal (alarm, supervisory, or trouble) the device identification, date and time of the occurrence. The printout differentiates alarm signals from all other printed indications.
E. Remote Access:
    1. FACP shall have the capability to provide Remote Access through a Dial-Up Service Modem using the public switched telephone system of a private switched telephone system. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.
    2. A personal computer or technician's laptop, configured with terminal emulation software shall have the ability to access the FACP for diagnostics, maintenance reporting and information gathering.
    3. FACP shall have the capability to provide third party access through a serial interface connection and be agency listed for specific interfaces and for the purpose.
    4. FACP shall have the capability to provide remote access via an Internet/Intranet Interface. The Internet interface shall provide an alternative access to system information using the familiar interface of a standard Internet browser. A remotely located fire professional can use this access to analyze control panel status during non-alarm conditions and can also use this information to assist local fire responders during alarm conditions.
F. Voice Alarm Notification: By speakers in areas as indicated on drawings.
G. Supervising Stations and Fire Department Connections:
    1. Public Fire Department Notification: By on-premises supervising station.
    2. Remote Supervising Station: UL-listed central station under contract to facility.
    3. Means of Transmission to Remote Supervising Station: Digital alarm communicator transmitter (DACT), 2 telephone lines.
H. Circuits:
    1. Initiating Device Circuits (IDC): Class B, Style A.
    2. Signaling Line Circuits (SLC) Within Single Building: Class B, Style 0.5.
    3. Notification Appliance Circuits (NAC): Class B, Style W.
I. Spare Capacity:
    1. Initiating Device Circuits: Minimum 25 percent spare capacity.
    2. Notification Appliance Circuits: Minimum 25 percent spare capacity.
    3. Speaker Amplifiers: Minimum 25 percent spare capacity.
    4. Master Control Unit: Capable of handling all circuits utilized to capacity without requiring additional components other than plug-in control modules.

2.04 FIRE SAFETY SYSTEMS INTERFACES

A. Supervision: Provide supervisory signals in accordance with NFPA 72 for the following:
    1. Sprinkler water control valves.
    2. Elevator shut-down control circuits.
B. Alarm: Provide alarm initiation in accordance with NFPA 72 for the following:
    1. Sprinkler water flow.
    2. Kitchen hood suppression activation; also disconnect fuel source from cooking equipment.
    3. Elevator lobby, elevator hoistway, and elevator machine room smoke detectors.
C. Elevators:
    1. Elevator lobby, hoistway, and machine room smoke detectors: Elevator recall for fire fighters' service.
    2. Elevator Machine Room Heat Detector: Shut down elevator power prior to hoistway sprinkler activation.

3. Sprinkler pressure or waterflow: Shut down elevator power prior to hoistway sprinkler activation.

D. HVAC:
   1. Duct Smoke Detectors: Close dampers indicated; shut down roof top unit and corresponding zone.
   2. Carbon Monoxide Detectors: Shut down roof top unit and corresponding zone.

E. Sound Reinforcement Systems: Shut down via relay as indicated on the drawings. Reset automatically upon alarm clear.

2.05 COMPONENTS

A. General:
   1. Provide flush mounted units where installed in finish areas; in unfinished areas, surface mounted unit are acceptable.
   2. Provide legible, permanent labels for each control device, using identification used in operation and maintenance data.

B. System Wiring: Wiring shall be as indicated on the drawings. Wire shall be in conduit inside walls and inaccessible ceilings, and where required by local code. Plenum rated power limited cable may be used where allowed by local code. Plenum rated cables shall be red in color. Individual conductor colors in conduit shall not correspond to other colors used for power wiring in building. Wire and cable shall be a type listed for its intended use by an approval agency acceptable to the Authority Having Jurisdiction (AHJ) and shall be installed in accordance with the appropriate articles from the current approved edition of NFPA 70: National Electric Code (NEC).
   1. Wire shall be power-limited fire alarm cable. Type FPLP#14 AWG solid conductor cable, unshielded.
      a. West Penn Wire #60993B(2-conductor); #60700B (4-conductor).
      b. Belden
      c. Superior
      d. Allied Wire
      e. Honeywell
      f. Engineer Approved Equal.

C. Fire Alarm Control Panel (FACP)
   1. General: Comply with UL 864, "Control Units for Fire-Protective Signaling Systems."
   2. The following FACP hardware shall be provided:
      a. Power Limited base panel with red cabinet and door, 120 VAC input power.
      b. 2,000 point capacity where (1) point equals (1) monitor (input) or (1) control (output).
      c. 2,000 points of Network Annunciation at FACP Display when applied as a Network Node.
      d. 2000 points of annunciation where one (1) point of annunciation equals:
         1) One (1) LED driver output on a graphic driver or 1 switch input on a graphic switch input module.
         2) One (1) LED on panel or 1 switch on panel.
      e. From all battery charging circuits in the system provide battery voltage and ammeter readouts on the FCP LCD Display.
      f. Municipal City Circuit Connection with Disconnect switch, 24VDC Remote Station (reverse polarity), local energy, shunt master box, or a form "C" contact output.
      g. One Auxiliary electronically resettable fused 2A @24VDC Output, with programmable disconnect operation for 4-wire detector reset.
      h. One Auxiliary Relay, SPDT 2A @32VDC, programmable as a trouble relay, either as normally energized or de-energized, or as an auxiliary control.
      i. Three (3) Class B or A (Style Y/Z) Notification Appliance Circuits (NAC; rated 3A@24VDC, resistive).

j. Four (4) form "C" Auxiliary Relay Circuits (Form C contacts rated 2A @ 24VDC, resistive), operation is programmable for trouble, alarm, supervisory of other fire response functions. Relays shall be capable of switching up to ½ A @ 120VAC, inductive.
k. The FACP shall support (6) RS-232-C ports and one service port.
l. Remote Unit Interface: supervised serial communication channel for control and monitoring of remotely located annunciators and I/O panels.
m. Programmable DACT for either Common Event Reporting or per Point Reporting.
n. Service Port Modem for dial in passcode access to all fire control panel information.

3. Cabinet: Lockable steel enclosure. Arrange unit so all operations required for testing or for normal care and maintenance of the system are performed from the front of the enclosure. If more than a single unit is required to form a complete control unit, provide exactly matching modular unit enclosures.
4. Alphanumeric Display and System Controls: Panel shall include an 80 character LCD display to indicate alarm, supervisory, and component status messages and shall include a keypad for use in entering and executing control commands.

D. Auto-call System Interface
1. When a fire alarm system using existing Auto-call XA loop devices requires expansion FACP shall be capable of interfacing to the XA loop via an interface module. This module shall allow the FACP to be selected to function as either the XA loop master controller (head end) or as a Data Gathering Panel as an intelligent device on the XA loop reporting to a remote master controller. Multiple XA Loop Interface Modules can be installed in the FACP allowing a variety of system expansion situations to be satisfied.

E. Remote LCD Annunciator
1. Provide where required a remote LCD Annunciator with the same "look and feel" as the FACP operator interface. The Remote LCD Annunciator shall use the same Primary Acknowledge, Silence, and Reset Keys, Status LEDs and LCD Display as the FACP.
2. Annunciator shall have super-twist LCD display with two lines of 40 characters each. Annunciator shall be provided with four (4) programmable control switches and associated LEDs.
3. Under normal conditions the LCD shall display a "SYSTEM IS NORMAL" message and the current time and date.
4. Should an abnormal condition be detected the appropriate LED (Alarm, Supervisory or Trouble) shall flash. The unit audible signal shall pulse for alarm conditions and sound steady for trouble and supervisory conditions.
5. The LCD shall display the following information relative to the abnormal condition of a point in the system:
a. 40 character custom location label.
b. Type of device (e.g., smoke, pull station, waterflow).
c. Point status (e.g., alarm, trouble).
6. Operator keys shall be key switch enabled to prevent unauthorized use. The key shall only be removable in the disabled position. Acknowledge, Silence and Reset operation shall be the same as the FACP.

F. Emergency Power Supply
1. General: Components include battery, charger, and an automatic transfer switch.
2. Battery: Sealed lead-acid or nickel cadmium type. Provide sufficient capacity to operate the complete alarm system in normal or supervisory (non-alarm) mode for a period of 24 hours. Following this period of operation on battery power, the battery shall have sufficient capacity to operate all components of the system, including all alarm indicating devices in alarm or

supervisory mode for a period of 5 minutes.

G. Addressable Manual Pull Stations
   1. Description: Addressable single- or double-action type, red LEXAN, with molded, raised-letter operating instructions of contrasting color. Station will mechanically latch upon operation and remain so until manually reset by opening with a key common with the control units.
   2. Protective Shield:
      a. At wall mounted locations: Where indicated on drawings, provide a tamperproof, clear LEXAN shield and red frame that easily fits over manual pull stations.
      b. At casework mounted locations: Where indicated on drawings, provide a tamperproof, low profile, clear LEXAN shield and red frame that easily fits over manual pull stations. The shield shall protrude a maximum of 2 inches and shall not interfere with operation of casework. Coordinate with casework provider.
      c. When shield is lifted to gain access to the station, a battery powered piercing warning horn shall be activated. The horn shall be silenced by lowering and realigning the shield. The horn shall provide 85dB at 10 feet and shall be powered by a 9 VDC battery.
      d. Protective shields shall be provided at all pull stations within childcare area.

H. Smoke Sensors
   1. General: Comply with UL 268, "Smoke Detectors for Fire Protective Signaling Systems." Include the following features:
      a. Factory Nameplate: Serial number and type identification.
      b. Operating Voltage: 24 VDC, nominal.
      c. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore normal operation.
      d. Plug-In Arrangement: Sensor and associated electronic components are mounted in a module that connects to a fixed base with a twist-locking plug connection. Base shall provide break-off plastic tab that can be removed to engage the head/base locking mechanism. No special tools shall be required to remove head once it has been locked. Removal of the detector head shall interrupt the supervisory circuit of the fire alarm detection loop and cause a trouble signal at the control unit.
      e. Each sensor base shall contain an LED that will flash each time it is scanned by the Control Unit (once every 4 seconds). In alarm condition, the sensor base LED shall be on steady.
      f. Each sensor base shall contain a magnetically actuated test switch to provide for easy alarm testing at the sensor location.
      g. Each sensor shall be scanned by the Control Unit for its type identification to prevent inadvertent substitution of another sensor type. Upon detection of a "wrong device", the control unit shall operate with the installed device at the default alarm settings for that sensor; 2.5% obscuration for photoelectric sensor, 135-deg F and 15-deg F rate-of-rise for the heat sensor, but shall indicate a "Wrong Device" trouble condition.
      h. The sensor's electronics shall be immune from false alarms caused by EMI and RFI.
      i. Sensors include a communication transmitter and receiver in the mounting base having a unique identification and capability for status reporting to the FACP. Sensor address shall be located in base to eliminate false addressing when replacing sensors.
      j. Removal of the sensor head for cleaning shall not require the setting of addresses.
   2. Type: Smoke sensors shall be of the photoelectric or combination photoelectric / heat type. Where acceptable per manufacturer specifications, ionization type sensors may be used.
   3. Bases: Relay output, sounder and isolator bases shall be supported alternatives to the standard base.
   4. Duct Smoke Sensor: Photoelectric type, with sampling tube of design and dimensions as recommended by the manufacturer for the specific duct size and installation conditions where

applied. Sensor includes relay as required for fan shutdown.

a. Environmental compensation, programmable sensitivity settings, status testing, and monitoring of sensor dirt accumulation for the duct sensor shall be provided by the FACP.
b. The Duct Housing shall provide a supervised relay driver circuit for driving up to 15 relays with a single "Form C" contact rated at 7A@ 28VDC or 10A@ 120VAC. This auxiliary relay output shall be fully programmable. Relay shall be mounted within 3 feet of HVAC control circuit.
c. Duct Housing shall provide a relay control trouble indicator Yellow LED.
d. Compact Duct Housing shall have a transparent cover to monitor for the presence of smoke. Cover shall secure to housing by means of four (4) captive fastening screws.
e. Duct Housing shall provide two (2) Test Ports for measuring airflow and for testing. These ports will allow aerosol injection in order to test the activation of the duct smoke sensor.
f. Duct Housing shall provide a magnetic test area and Red sensor status LED.
g. For maintenance purposes, it shall be possible to clean the duct housing sampling tubes by accessing them through the duct housing front cover.
h. Each duct sensor shall have a Remote Test Station with an alarm LED and test switch.
i. Where indicated provide a NEMA 4X weatherproof duct housing enclosure shall provide for the circulation of conditioned air around the internally mounted addressable duct sensor housing to maintain the sensor housing at its rated temperature range. The housing shall be UL Listed to Standard 268A.

I. Heat Sensors
1. Thermal Sensor: Combination fixed-temperature and rate-of-rise unit with plug-in base and alarm indication lamp; 135-deg F fixed-temperature setting except as indicated.
2. Thermal sensor shall be of the epoxy encapsulated electronic design. It shall be thermistor-based, rate-compensated, self-restoring and shall not be affected by thermal lag.
3. Sensor fixed temperature sensing shall be independent of rate-of-rise sensing and] programmable to operate at 135-deg F or 155-deg F. Sensor rate-of-rise temperature detection shall be selectable at the FACP for either 15-deg F or 20-deg F per minute.
4. Sensor shall have the capability to be programmed as a utility monitoring device to monitor for temperature extremes in the range from 32-deg F to 155-deg F.

J. Carbon Monoxide Sensors
1. General: Carbon monoxide detector listed for connection to fire alarm system.
a. Mounting: Adapter plate for outlet box mounting.
b. Testable by introducing test carbon monoxide into the sensing cell.
c. Detector shall provide alarm contacts and trouble contacts.
d. Detector shall send trouble alarm when nearing end-of-life, power supply problems, or internal faults.
e. Comply with UL 2075.
f. Locate, mount, and wire per manufacturer's written instructions.
g. Provide means for addressable connection to fire alarm system.
h. Test button simulates an alarm condition.

K. Addressable Circuit Interface Modules
1. Addressable Circuit Interface Modules: Arrange to monitor one or more system components that are not otherwise equipped for addressable communication. Modules shall be used for monitoring of waterflow, valve tamper, non-addressable devices, and for control of evacuation indicating appliances and AHU systems.
2. Addressable Circuit Interface Modules will be capable of mounting in a standard electric outlet box. Modules will include cover plates to allow surface or flush mounting. Modules will receive

their operating power from the signaling line or a separate two wire pair running from an appropriate power supply as required.

3. There shall be the following types of modules:
   a. Type 1: Monitor Circuit Interface Module:
      1) For conventional 2-wire smoke detector and/or contact device monitoring with Class B or Class A wiring supervision. The supervision of the zone wiring will be Class B. This module will communicate status (normal, alarm, trouble) to the FACP.
      2) For conventional 4-wire smoke detector with Class B wiring supervision. The module will provide detector reset capability and over-current power protection for the 4-wire detector. This module will communicate status (normal, alarm, trouble) to the FACP.
   b. Type 2: Line Powered Monitor Circuit Interface Module
      1) This type of module is an individually addressable module that has both its power and its communications supplied by the two wire multiplexing signaling line circuit. It provides location specific addressability to an initiating device by monitoring normally open dry contacts. This module shall have the capability of communicating four zone status conditions (normal, alarm, current limited, trouble) to the FACP.
      2) This module shall provide location specific addressability for up to five initiating devices by monitoring normally closed or normally open dry contact security devices. The module shall communicate four zone status conditions (open, normal, abnormal, and short). The two-wire signaling line circuit shall supply power and communications to the module.
   c. Type 3: Single Address Multi-Point Interface Modules
      1) This multi-point module shall provide location specific addressability for four initiating circuits and control two output relays from a single address. Inputs shall provide supervised monitoring of normally open, dry contacts and be capable of communicating four zone status conditions (normal, open, current limited, and short). The input circuits and output relay operation shall be controlled independently and disabled separately.
      2) This dual point module shall provide a supervised multi-state input and a relay output, using a single address. The input shall provide supervised monitoring of two normally open, dry contacts with a single point and be capable of communicating four zone status conditions (normal, open, current limited, and short). The two-wire signaling line circuit shall supply power and communications to the module.
      3) This dual point module shall monitor an unsupervised normally open, dry contact with one point and control an output relay with the other point, using a single address. The two-wire signaling line circuit shall supply power and communications to the module.
   d. Type 4: Line Powered Control Circuit Interface Module
      1) This module shall provide control and status tracking of a Form "C" contact. The two-wire signaling line circuit shall supply power and communications to the module.
   e. Type 5: 4-20 mA Analog Monitor Circuit Interface Module
      1) This module shall communicate the status of a compatible 4-20 mA sensor to the FACP. The FACP shall annunciate up to three threshold levels, each with custom action message; display and archive actual sensor analog levels; and permit sensor calibration date recording.
4. All Circuit Interface Modules shall be supervised and uniquely identified by the control unit. Module identification shall be transmitted to the control unit for processing according to the program instructions. Modules shall have an on-board LED to provide an indication that the module is powered and communicating with the FACP. The LEDs shall provide a troubleshooting aid since the LED blinks on poll whenever the peripheral is powered and

communicating.

L. Addressable Alarm Notification Appliances
   1. Addressable Notification Appliances: The Contractor shall furnish and install Addressable Notification Appliances and accessories to operate on compatible signaling line circuits (SLC).
      a. Addressable Notification appliance operation shall provide power, supervision and separate control of horns and strobes over a single pair of wires. The controlling channel (SLC) digitally communicates with each appliance and receives a response to verify the appliance's presence on the channel. The channel provides a digital command to control appliance operation. SLC channel wiring shall be unshielded twisted pair (UTP), with a capacitance rating of less than 60pf/ft and a minimum 3 twists (turns) per foot.
      b. Class B (Style 4) notification appliances shall be wired without requiring traditional in/out wiring methods; addressable "T" Tapping shall be permitted. Up to 63 appliances can be supported on a single channel.
      c. Each Addressable notification appliance shall contain an electronic module and a selectable address setting to allow it to occupy a unique location on the channel. This on-board module shall also allow the channel to perform appliance diagnostics that assist with installation and subsequent test operations. A visible LED on each appliance shall provide verification of communications and shall flash with the appliances address setting when locally requested using a magnetic test tool.
   2. Addressable Controller: Addressable Controller shall supervise Channel (SLC) wiring, communicate with and control addressable notification appliances. It shall be possible to program the High/Lo setting of the audible (horn) appliances by channel from the addressable controller.
   3. Horn: Addressable horn shall be listed to UL 464. Horn appliances shall have a High/Lo Setting, programmable by channel from the addressable controller or by appliance from the host FACP. The horn shall have a minimum sound pressure level of 83 or 89 dBA @ 24VDC. The horn shall mount directly to a standard single gang, double gang or 4" square electrical box, without the use of special adapter or trim rings. Appliances shall be wired with UTP conductors, having a minimum of 3 twists per foot.
   4. Visible/Only: Addressable strobe shall be listed to UL 1971. The V/O shall consist of a xenon flash tube and associated lens/reflector system. The V/O enclosure shall mount directly to standard single gang, double gang or 4" square electrical box, without the use of special adapters or trim rings. Appliances shall be wired with UTP conductors, having a minimum of 3 twists per foot. V/O appliances shall be provided with different minimum flash intensities of 15cd, 75cd and 110cd. Provide a label inside the strobe lens to indicate the listed candela rating of the specific Visible/Only appliance.
   5. Audible/Visible: Addressable combination Audible/Visible (A/V) Notification Appliances shall be listed to UL 1971 and UL 464. The strobe light shall consist of a xenon flash tube and associated lens/reflector system. Provide a label inside the strobe lens to indicate the listed candela rating of the specific strobe. The horn shall have a minimum sound pressure level of 83 or 89 dBA @ 24VDC. The audible/visible enclosure shall mount directly to standard single gang, double gang or 4" square electrical box, without the use of special adapters or trim rings. Appliances shall be wired with UTP conductors, having a minimum of 3 twists per foot. The appliance shall be capable of two-wire synchronization with one of the following options:
      a. Synchronized Strobe with Horn on steady
      b. Synchronized Strobe with Temporal Code Pattern on Horn
      c. Synchronized Strobe with March Time cadence on Horn
      d. Synchronized Strobe firing to NAC sync signal with Horn silenced

6. Speaker/Visible: Combination Speaker/Visible (S/V) units combine the speaker and visible functions into a common housing. The S/V shall be listed to UL 1971 and UL 1480. Addressable functionality controls visible operation, while the speaker operates on a 25VRMS or 70.7VRMS NAC.
    a. Twisted/shielded wire is required for speaker connections on a standard 25VRMS or 70.7VRMS NAC using and UTP conductors, having a minimum of 3 twists per foot is required for addressable strobe connections.
    b. The following taps are available: 0.25W, 0.50W, 1.0W and 2.0W. At the 1.0W tap, the speaker has minimum UL rated sound pressure level of 84dBA at 10 feet.
    c. The S/V shall have a frequency response of 400 to 4000 Hz for Fire Alarm and 125 to 12kHz for General Signaling.
    d. The S/V installs directly to a 4" square, 1 1/2 in. deep electrical box with 1 1/2" extension.
7. Isolator Module: Isolator module provides short circuit isolation for addressable notification appliance SLC wiring. Isolator shall be listed to UL 864. The Isolator shall mount directly to a minimum 2 1/8" deep, standard 4" square electrical box, without the use of special adapter or trim rings. Power and communications shall be supplied by the Addressable Controller channel SLC; dual port design shall accept communications and power from either port and shall automatically isolate one port from the other when a short circuit occurs. The following functionality shall be included in the Isolator module:
    a. Report faults to the host FACP.
    b. On-board Yellow LED provides module status.
    c. After the wiring fault is repaired, the Isolator modules shall test the lines and automatically restore the connection.
8. Accessories: The contractor shall furnish the necessary accessories.

M. NAC Power Extender
1. The IDNet NAC Power Extender panel shall be a stand-alone panel capable of powering a minimum of 4 notification appliance circuits. Notification appliance circuits shall be Class B Style Y rated at 2 amps each. Panel shall provide capability to be expanded to 8 notification appliance circuits.
2. The internal power supply & battery charger shall be capable of charging up 12.7 Ah batteries internally mounted or 18Ah batteries mounted in an external cabinet.
3. The NAC extender panel may be mounted close to the host control panel or can be remotely located. The IDNET Addressable NAC Extender Panel when connected to an addressable panel shall connect to the host panel via an IDNet communications channel. Via the IDNET channel each output NAC can be individually controlled for general alarm or selective area notification.
4. For IDNet connected NAC extender panels up to five panels can be connected on a single IDNet channel.
5. When connected to a conventional (non-addressable panel) one or two standard notification appliance circuits from the main control panel may be used to activate all the circuits on the NAC power extender panel.
6. Alarms from the host fire panel shall signal the NAC power extender panel to activate. The panel shall monitor itself and each of its NACs for trouble conditions and shall report trouble conditions to the host panel.

N. Contractor shall obtain from the Fire Alarm System Manufacturer written instruction regarding the appropriate wire/cable to be used for this installation. No deviation from the written instruction shall be made by the Contractor without the prior written approval of the Fire Alarm System Manufacturer.

O. Color Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color code for alarm initiating device circuits wiring and a different color code for supervisory circuits. Color-code notification appliance circuits differently from alarm-initiating circuits. Paint fire

alarm system junction boxes and covers red.

P. Surge Protection: In accordance with IEEE C62.41.2 category B combination waveform and NFPA 70; except for optical fiber conductors.
   1. Equipment Connected to Alternating Current Circuits: Maximum let through voltage of 350 V(ac), line-to-neutral, and 350 V(ac), line-to-line; do not use fuses.
   2. Initiating Device Circuits, Notification Appliance Circuits, and Communications Circuits: Provide surge protection at each point where circuit exits or enters a building; rated to protect applicable equipment; for 24 V(dc) maximum dc clamping voltage of 36 V(dc), line-to-ground, and 72 V(dc), line-to-line.
   3. Signaling Line Circuits: Provide surge protection at each point where circuit exits or enters a building, rated to protect applicable equipment.

Q. Locks and Keys: Deliver keys to Owner.
   1. Provide the same standard lock and key for each key operated switch and lockable panel and cabinet; provide 5 keys of each type.

R. Instruction Charts: Printed instruction chart for operators, showing steps to be taken when a signal is received (normal, alarm, supervisory, and trouble); easily readable from normal operator's station.
   1. Frame: Stainless steel or aluminum with polycarbonate or glass cover.
   2. Provide one for each control unit where operations are to be performed.
   3. Obtain approval of Owner prior to mounting; mount in location acceptable to Owner.
   4. Provide extra copy with operation and maintenance data submittal.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with applicable codes, NFPA 72, NFPA 70, and the contract documents.

B. Conceal all wiring, conduit, boxes, and supports where installed in finished areas.

C. All wiring on second floor exercise area shall be concealed in gypsum board soffits. Where visible routing is required, wiring shall be straight, level, and plumb, and secured at 36 inch intervals to avoid sagging. Low voltage cable straps must be used.

D. Obtain Engineer's approval before modifying any locations of devices indicated on drawings.

E. Install instruction cards and labels.

3.02 INSPECTION AND TESTING FOR COMPLETION

A. Notify Owner 7 days prior to beginning completion inspections and tests.

B. Notify authorities having jurisdiction and comply with their requirements for scheduling inspections and tests and for observation by their personnel.

C. Provide the services of the installer's supervisor or person with equivalent qualifications to supervise inspection and testing, correction, and adjustments.

D. Prepare for testing by ensuring that all work is complete and correct; perform preliminary tests as required.

E. Provide all tools, software, and supplies required to accomplish inspection and testing.

F. Perform inspection and testing in accordance with NFPA 72 and requirements of local authorities; document each inspection and test.

G. Correct defective work, adjust for proper operation, and retest until entire system complies with contract documents.

H. Diagnostic Period: After successful completion of inspections and tests, Operate system in normal mode for at least 14 days without any system or equipment malfunctions.
   1. Record all system operations and malfunctions.
   2. If a malfunction occurs, start diagnostic period over after correction of malfunction.
   3. Owner will provide attendant operator personnel during diagnostic period; schedule training to allow Owner personnel to perform normal duties.

4. At end of successful diagnostic period, fill out and submit NFPA 72 "Inspection and Testing Form."

3.03 PERSONNEL INSTRUCTION

A. Provide the following instruction to designated Owner personnel:
   1. Hands-On Instruction: On-site, using operational system.
B. Basic Operation: One-hour sessions for attendant personnel, security officers, and engineering staff; combination of classroom and hands-on:
   1. Initial Training: 1 session pre-closeout.
C. Furnish the services of instructors and teaching aids; have copies of operation and maintenance data available during instruction.

3.04 CLOSEOUT

A. Closeout Demonstration: Demonstrate proper operation of all functions to Owner.
   1. Be prepared to conduct any of the required tests.
   2. Have at least one copy of operation and maintenance data, preliminary copy of project record drawings, input/output matrix, and operator instruction chart(s) available during demonstration.
   3. Have authorized technical representative of control unit manufacturer present during demonstration.
   4. Demonstration may be combined with inspection and testing required by authority having jurisdiction; notify authority having jurisdiction in time to schedule demonstration.
   5. Repeat demonstration until successful.
B. Substantial Completion of the project cannot be achieved until inspection and testing is successful and:
   1. Specified diagnostic period without malfunction has been completed.
   2. Approved operating and maintenance data has been delivered.
   3. All aspects of operation have been demonstrated to Owner.
   4. Final acceptance of the fire alarm system has been given by authorities having jurisdiction.
   5. Occupancy permit has been granted.
   6. Specified pre-closeout instruction is complete.

3.05 MAINTENANCE

A. See Division 1 specification Execution Requirements, for additional requirements relating to maintenance service.
B. Provide to Owner, at no extra cost, a written maintenance contract for entire manufacturer's warranty period, to include the work described below.
C. Perform routine inspection, testing, and preventive maintenance required by NFPA 72, including:
   1. Maintenance of fire safety interface and supervisory devices connected to fire alarm system.
   2. Repairs required, unless due to improper use, accidents, or negligence beyond the control of the maintenance contractor.
   3. Record keeping required by NFPA 72 and authorities having jurisdiction.
D. Provide trouble call-back service upon notification by Owner:
   1. Provide on-site response within 2 hours of notification.
   2. Include allowance for call-back service during normal working hours at no extra cost to Owner.
   3. Owner will pay for call-back service outside of normal working hours on an hourly basis, based on actual time spent at site and not including travel time; include hourly rate and definition of normal working hours in maintenance contract.
E. Provide a complete description of preventive maintenance, systematic examination, adjustment, cleaning, inspection, and testing, with a detailed schedule.
F. Maintain a log at each fire alarm control unit, listing the date and time of each inspection and call-back visit, the condition of the system, nature of the trouble, correction performed, and parts replaced. Submit duplicate of each log entry to Owner's representative upon completion of site visit.

G. Comply with Owner's requirements for access to facility and security.

3.06 MONITORING

A. Fire Alarm Monitoring services shall be contracted by Owner with Life Safety Fire & Security Solutions.
   1. Contact Owner prior to engaging Life Safety Fire & Security Solutions.
   2. Contact, Life Safety Fire & Security Solutions, Tempe AZ: Leo Gonzales, 716-382-7965.

END OF SECTION

SECTION 28 31 19
DISTRIBUTED ANTENNA SYSTEM (EMERGENCY RESPONSE)

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This section includes performance requirements and products for a bi-directional amplifier system. A bi-directional radio frequency (RF) amplifier will be required inside the building. Antennas will be installed where indicated in the building to transmit and receive the radio signals. The system shall ensure full building coverage for the two way communications for the emergency services in the area. An outdoor donor antenna will be mounted on the roof as indicated. All required cabling shall be provided for a complete and functional system. The Contractor shall provide a fully functional Distributed Antenna System compliant with local first responder emergency services requirements and the following specifications.

1.03 IN-BUILDING DAS SPECIFICATION

A. Description: For purposes of this specification, a distributed antenna system is an in-building wireless system facilitating frequencies as required by the authority having jurisdiction, designed to serve emergency response services. The system antenna design and layout shall be engineered and configured to meet local Fire Department coverage requirements. Calculations shall be provided for each supported service, to verify the signal levels required to maintain the specified reliability and coverage objectives.

B. The system shall meet all requirements for the local fire department. All tests and documentation shall be completed per local codes.

C. The in-building Distributed Antenna System (DAS) solution must be implemented with proven, type-accepted, state of the art technology.

D. The DAS system proposed by the Contractor must comply with the following design, coverage and reliability requirements:

1. Active Signal Handling
    a. The in-building DAS shall have active powered elements that filter and amplify signals on a band specific basis to consistently deliver wireless services at the appropriate power levels.
2. Signal Distribution
    a. The in-building DAS shall utilize a coaxial distribution cable with passive, broadband antennas in the distribution area.
3. Life Safety Centralized Power
    a. The in-building DAS system shall be powered through a local UPS. The UPS shall provide full operation of the system for a minimum of 12 hours at rated output in the event of a power failure. See below for UPS specification.
4. Delivered Audio Quality (DAQ) level shall be 3.4 or above. DAQ 3.4 is defined as "speech understandable without repetition. Some noise/distortion present."

E. Acceptance Testing Procedure

1. Upon completion of installation, The Contractor shall have the radio system tested to ensure that two-way communications coverage in the building and on each floor meets the specified performance requirements. Each floor of the building shall be divided into a grid of 20 equal squares or a grid spacing of no more than 50 feet by 50 feet. Testing criterial shall be in accordance with local code requirements. Signal level measurements shall be made using a test

receiver with sensitivity and thermal noise floor equal to or better than the Department of Safety radio, taking at least one sample measurement of the radio system control channel within each

accessible grid location.

2. Ensure all documentation is ready for final inspection.
    a. Document all plots for transmission lines. Show that the TDR instrument is calibrated to NIST specifications.
    b. Provide a chart showing loss for each transmission line.
    c. Provide all engineering calculations in plan set.
        1) Link budget from interior antennas as well as link budget for the donor antenna to the public safety repeater site. Include both downlink and uplink calculations.
    d. Document downlink field strengths on the gridded off floor plan set.
    e. Document and show downlink and uplink noise floor as measured with a spectrum analyzer.
    f. Document and show spectrum plot of the downlink signal as present from the donor antenna.
    g. Capture all BDA configuration pages and provide a copy in documentation.
    h. Show on the air downlink plot from the spectrum analyzer as measured at the output of the BDA.
3. If the building fails to achieve the coverage requirement, the Contractor shall provide additional DAS equipment as required and conduct a new acceptance test.
4. Contactor shall pay all fees associated with testing the system.

1.04 RANGE OF SERVICE

A. Public Safety Spectrum
    1. The in-building DAS head end equipment shall be capable of supporting the spectrum, services, applications, and technologies required by the local fire department.
    2. System Overview
        a. The radios DAS head end equipment will be located as indicated in the Contract Documents.
        b. IEEE 802.11 a/b/g/n will not be part of the DAS design.
    3. The primary role of the DAS system is to provide life safety radio communications. As such, reliability should be a primary goal of the design.
    4. Recommended Coverage Design Goal
        a. The radio system control channel signal level shall exceed -95dBm at 95% or more of the locations measured within each grid area. Equivalently, the service area reliability shall be 95% or greater on each floor of the structure.
    5. Failure Detection
        a. DAS equipment shall have failure detection circuitry which provides detection of mechanical, electrical, and power failure of the DAS, as well as oscillation detection capability which will reduce the amplifier output to zero in the event of a system oscillation. Detection of any failure shall result in a distinct audible notification at a constantly attended location approved by the Fire Department.

1.05 SUBMITTALS

A. Product Data:
    1. Product Data for all items provided under this Section.
        a. Indicate materials, finishes, load ratings, dimensions, listings, approvals and attachment methods.
        b. Indicate how the components of an item or system are assembled, interconnected, function together and how they will be installed on the project.
        c. Highlight with yellow or blue marker, or indicate with arrow stamp, adequate information to demonstrate materials being submitted fully comply with contract documents.
        d. Indicate listing by UL or other approved testing agency.
        e. Manufacturers' Cable Installation Instructions

B. System Block Diagram: Provide a block diagram illustrating system components and connectivity requirements. At a minimum label: cabling requirements, electrical requirements, and related system components. Include detailed diagrams of head end and rooftop equipment.
C. Operation and Maintenance Data: For system components to include in emergency, operation, and maintenance manuals.
D. Shop Drawings
    1. Provide detailed plan views (minimum scale 3/32"=1'-0") and elevations of all telecommunications spaces showing field conditions, ancillary room components, dimensions, equipment racks, termination blocks, patch panels, cable paths and workspace requirements for access to equipment and cable connections.
    2. Ratings of items.
    3. Fire rating of room penetrations.
    4. Coordinate with other division shop drawings and submittals. Identify interface points and indicate method of connection.
    5. Provide plan drawings of each floor of each building showing:
        a. Routing for all cables installed under this Work.
    6. Reports and Schedules
        a. Provide Cable Termination Schedules for all cables installed under this work, with the following information:
            1) Backbone cables
            2) Horizontal (antenna) distribution cables
    7. Provide sample reports showing the proposed format for cable test reports.
E. As Built Drawings: The Contractor shall provide a complete set of as-built drawings.
F. Permits: Contractor shall obtain and submit required permitting for the installation of the system. Contractor shall provide all required submittals to the local authority having jurisdiction and the Fire Department. Contractor shall fill out and provide design and engineering specifications per local requirements to obtain permit.

1.06 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements listed below.
B. The installation shall be performed by a company that has been in the business of installing DAS systems for a period of at least three years.
C. Response times for remote diagnostics shall be within two hours, on site diagnostics within 8 hours, and parts availability / service restoration within 24 hours.
D. References: Provide manufacturer references for five projects of a similar size / scope where the system proposed is currently installed. Provide contact information at each site as well as any written recommendations available.
E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
F. Comply with NFPA 70 for components and installation.
G. Comply with local Fire Code.

1.07 WARRANTY

A. Provide a warranty of 2 years from substantial completion.

PART 2 PRODUCTS

2.01 EQUIPMENT MANUFACTURERS

A. All equipment shall be the product of a manufacturer that has been in the business of manufacturing like product and financially stable for a period of at least five years. The Contractor shall provide equipment references as required in the request for proposals for any substitutions.

B. The Contractor shall commit, in writing, to factory support for the primary components of the DAS system, providing hardware availability and support for a minimum period of ten years following system implementation. The primary components shall include all equipment by a single or multiple manufacturers, totaling at least 70% of the capital equipment cost.

2.02 PARTS AND EQUIPMENT SPECIFICATIONS

A. Contractor shall provide parts and equipment list, and specifications for all components of the system, including:
   1. Shielded Coaxial Cable and connectors.
   2. Coaxial splitters and terminators.
   3. Interior Antennas.
   4. Donor antennas.
   5. Radios, amplifiers, head end equipment.

2.03 BI-DIRECTIONAL AMPLIFIER (BDA)

A. Maximum output power: As required to provide coverage for entire building.
B. Minimum gain: 80 dB.
C. Frequency band uplink/downlink: as required by authority having jurisdiction.
D. Technology:
   1. Digital repeater with channel filtering.
   2. Signal to be repeated is FM, system must be capable of P25 digital.
E. Input and output impedance: 50 ohms.
F. Enclosure: NEMA 4
G. Additional outputs: System shall have alarm output.
H. BDA shall included re-tunable or replaceable filters to acommodate pass band changes. The use of non-adjustable and non-replaceable RF duplexer filters is prohibited.

2.04 ANTENNAS

A. Exterior Donor Antenna: Yagi 12 dBd gain.
B. Interior Omni-directional antenna: 1.5 dBi gain.
C. Interior directional panel antenna: 6 dBd gain.

2.05 DIRECTIONAL COUPLERS & SPLITTERS

A. Directional Couplers
B. Power Splitter

2.06 WIRING AND CABLES

A. Coax: ½" coax transmission line.
   1. Jack material: PE.
   2. Outer conductor material: Corrugated copper.
   3. Dielectric material: Foam PE.
   4. Inner conductor material: Copper-clad aluminum wire.
   5. Jacket color: Black.
   6. Cable shall be plenum rated.
   7. Andrews LDF4-50A.
B. Jumper Cables:
   1. Jumper cables shall be RJ-142 jumpers cables with type "N" male connectors on each end.

2.07 LIGHTNING PROTECTION DEVICE

A. Provide lightning protection equipment on cabling entering the building from the exterior donor antenna. Ground antenna to building grounding system.

2.08 UNINTERRUPTIBLE POWER SYSTEM

Rack-Mounted Uninterruptible Power Supply (UPS) shall be furnished and installed for the radio

repeater system with the following requirements:

1. 19” rack/cabinet mountable and two rack units in height. Provide necessary mounting hardware

2. Rated for 12-hours of backup capacity.
3. Six NEMA 5-15R receptacles and 10’ line cord with NEMA 5-15P plug.
4. Approved manufacturer: American Power Conversion.
5. Approved equals by Tripp Lite and Liebert.

2.09 SPARE MATERIALS

A. Furnish spare materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Provide not less than one of each item listed below. Deliver extra materials to Owner.
1. Antennas: One of each type installed.
2. Passive Components (taps, combiners, splitters, couplers, etc.): One of each type installed.
3. Cable: 100 feet (30 m); each type used
4. Jumper Cables: Two for every type installed.

PART 3 EXECUTION

3.01 INSTALLATION

A. The installation shall be performed by a company that has been in the business of installing DAS systems for a period of at least three years.

3.02 COORDINATION

A. Design coordination is required for this Work. Coordination with General Contractor and the design team is required to address system integration and structure cabling design.
B. Coordinate Work of this Section with on-site General Contractor and their sub-contractors.
C. Coordinate layout and installation of distributed antenna system equipment and antenna cable with other construction that penetrates ceilings or is supported by them, including but not limited to light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.
D. Coordinate locations of any equipment that differs from that shown on the Construction Documents with the Engineer and Owner prior to installation. All difference shall be clearly noted in the submittals. Special consideration shall be taken to install antennas in areas with the least visual impact. All cabling shall be concealed wherever possible and adequately supported.
E. Coordinate installation and system level measurement with engineer, Owner, vendors and installation contractors.
F. Coordinate with the local public safety jurisdiction and secure "Approval to Carry" letter from the owner of each public safety radio system carried by the DAS.

3.03 CABLE INSTALLATION

A. Coaxial cable, and other associated cable and wiring shall be installed in sleeves indicated on the Construction Documents for antenna system. Provide proper support for all cabling. Cabling shall be installed in a neat and workmanlike manor. Any cabling deemed by the Engineer to be improperly installed or improperly supported shall be fixed by the Contractor at no expense to the Owner. Provide j-hooks where cable trays are not present, and install cabling in conduit where installed in exposed finished areas.
B. Coaxial cables are to be terminated at bulkheads in each designated equipment room. Provide proper grounding on each bulkhead.
C. Contractor will provide as-built documentation of the installed cable system.

3.04 IDENTIFICATION

A. Comply with Division 26 Section "Identification for Electrical Systems."
B. All installed cable shall be labeled "INTERNAL DISTRIBUTED ANTENNA SYSTEM CABLE" every twenty feet.
C. Provide an information sign labeled “THIS BUILDING IS EQUIPPED WITH A RADIO REPEATER SYSTEM” conspicuously posted above fire control panel.

3.05 FIELD QUALITY CONTROL

A. Contractor shall provide detailed documentation specifying test procedures for installed cabling, antennas, radios, amplifiers, coverage, and management system.

B. Perform the following field adjustments, tests, and inspections and prepare test reports:

1. Perform operational-system tests to verify compliance with the Specifications and make adjustments to bring system into compliance.

C. Remove and replace malfunctioning units and retest.

D. Provide copies of test results to the Engineer.

3.06 PROTECTION

A. Protect finished installation until final acceptance of the project.

3.07 DEMONSTRATION

A. Provide training to Owner's representative. Provide 2 hours of training. Refer to Division 01 Section "Demonstration and Training"

3.08 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who has completed installation of distributed antenna systems similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance. Contractor or installer will provide.

END OF SECTION

SECTION 28 31 20
DISTRIBUTED ANTENNA SYSTEM (INTERNAL COMMUNICATION)

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This section includes performance requirements and products for a four-channel bi-directional repeater system. A bi-directional radio frequency (RF) repeater will be required inside the building. Antennas will be installed in and out of the building to transmit and receive the radio signals. The system shall ensure full building coverage for the two-way communications services in the area. All required cabling shall be provided for a complete and functional system. The Contractor shall provide a fully functional Distributed Antenna System compliant with national and local requirements and the following specifications. Contractor shall provide license for operation.

1.03 IN-BUILDING DISTRIBUTED ANTENNA SYSTEM SPECIFICATION

A. Description: For purposes of this specification, a distributed antenna system (DAS) is an in-building Wireless system facilitating frequencies as required by Life Time system, designed to serve internal communication services. The system antenna design and layout shall be engineered and configured to meet national and local requirements. Calculation shall be provided for each supported service, to verify the signal levels required to maintain the specified reliability and coverage objectives.

B. The in-building Distributed Antenna System (DAS) solution must be implemented with proven, type-accepted, state of the art technology.

C. The DAS system proposed by the Contractor must comply with the following design, coverage and reliability requirements:

1. Active Signal Handling
    a. The in-building DAS shall have active powered elements that filter and amplify signals on a band specific basis to consistently deliver wireless services at the appropriate power levels.
2. Signal Distribution
    a. The in-building DAS shall utilize a coaxial distribution cable with passive, broadband antennas in the distribution area.
3. Centralized Power
    a. The in-building DAS system shall be powered through a local UPS.
4. Delivered Audio Quality (DAQ) level shall be 3.4 or above. DAQ 3.4 is defined as “speech understandable without repetition. Some noise/distortion present.”

D. Acceptance Testing Procedure

1. Upon completion of installation, The Contractor shall have the radio system tested to ensure that two-way communications coverage in the building and on each floor meets the specified performance requirements. Each floor of the building shall be divided into a grid of 20 equal squares or a grid spacing of no more than 50 feet by 50 feet. Signal level measurements shall be made using a test receiver with sensitivity and thermal noise floor approved by taking at least one sample measurement of the radio system control channel within each accessible grid location.
2. Ensure all documentation is ready for final inspection.
    a. Document all plots for transmission lines. Show that the Time-Domain Reflectometer (TDR) instrument is calibrated to NIST specifications.
    b. Provide a chart showing loss for each transmission line.
    c. Provide all engineering calculations in plan set.

1) Link budget from interior antennas as well as link budget for the exterior antenna to the repeater. Include both downlink and uplink calculations.

d. Document downlink field strengths on the gridded off floor plan set.

e. Document and show downlink and uplink noise floor as measured with a spectrum analyzer.

f. Capture all Bi-Directional Repeater configuration pages and provide a copy in documentation.

g. Show on the air downlink plot from the spectrum analyzer as measured at the output of the repeater.

3. If the building fails to achieve the coverage requirement, the Contractor shall provide additional DAS equipment as required and conduct a new acceptance test.

4. Contactor shall pay all fees associated with testing the system.

1.04 RANGE OF SERVICE

A. Life Time Spectrum

1. The in-building DAS head end equipment shall be capable of supporting the spectrum, services, applications, and technologies required by Life Time.

2. System Overview

a. System shall support 4 channel AWR D6000 digital two-way radios in use by Life Time.

b. Coordinate the location of the radio DAS head end equipment with Life Time IT department to ensure proper MDF rack location.

c. System shall serve all area of the Life Time Premises including parking area and outdoor amenities.

d. IEEE 802.11 a/b/g/n will not be part of the DAS design.

3. The primary role of the DAS system is to provide radio communications. As such, reliability should be a primary goal of the design.

4. Recommended Coverage Design Goal

a. The radio system control channel signal level shall exceed —95dBm at 95% or more of the locations measured within each grid area. Equivalently, the service area reliability shall be 95% or greater on each floor of the structure.

5. Failure Detection

a. DAS equipment shall have failure detection circuitry which provides detection of mechanical, electrical, and power failure of the DAS, as well as oscillation detection capability which will reduce the repeater output to zero in the event of a system oscillation. Detection of any failure shall result in a distinct audible notification at a constantly attended location approved by Life Time.

1.05 SUBMITTALS

A. Product Data:

1. Product Data for all items provided under this Section.

a. Indicate materials, finishes, load ratings, dimensions, listings, approvals and attachment

b. Indicate how the components of an item or system are assembled, interconnected, function together and how they will be installed on the project.

c. Highlight with yellow or blue marker, or indicate with arrow stamp, adequate information to demonstrate materials being submitted fully comply with contract documents.

d. Indicate listing by UL or other approved testing agency.

e. Manufacturers' Cable Installation Instructions

B. System Block Diagram: Provide a block diagram illustrating system components and connectivity requirements. At a minimum label: cabling requirements, electrical requirements, and related system components. Include detailed diagrams of head end and rooftop equipment.

C. Operation and Maintenance Data: For system components to include in emergency, operation, and maintenance manuals.

D. Shop Drawings
    1. Provide detailed plan views (minimum scale 3/32"=1'-0") and elevations of all telecommunications spaces showing field conditions, ancillary room components, dimensions, equipment racks, termination blocks, patch panels, cable paths and workspace requirements for access to equipment and cable connections.
    2. Ratings of items.
    3. Fire rating of room penetrations.
    4. Coordinate with other division shop drawings and submittals. Identify interface points and indicate method of connection.
    5. Provide plan drawings of each floor of each building showing:
        a. Routing for all cables installed under this Specification.
    6. Reports and Schedules
        a. Provide Cable Termination Schedules for all cables installed under this work, with the following information:
            1) Backbone cables
            2) Horizontal (antenna) distribution cables
    7. Provide sample reports showing the proposed format for cable test reports.
E. As Built Drawings: The Contractor shall provide a complete set of as-built drawings.
F. Permits: Contractor shall obtain and submit required permitting for the installation of the system. Contractor shall provide all required submittals to the local authority having jurisdiction and the Fire Department. Contractor shall fill out and provide design and engineering specifications per local requirements to obtain permit.

1.06 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements listed below.
B. The installation shall be performed by a company that has been in the business of installing DAS systems for a period of at least three years.
C. Response times for remote diagnostics shall be within two hours, on site diagnostics within 5 days, and parts availability / service restoration within 10 days.
D. References: Provide manufacturer references for five projects of a similar size / scope where the system proposed is currently installed. Provide contact information at each site as well as any written recommendations available.
E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
F. Comply with NFPA 70 for components and installation.
G. Comply with local Fire Code.

1.07 WARRANTY

A. Provide a warranty of 2 years from substantial completion.

PART 2 - PRODUCTS

2.01 EQUIPMENT MANUFACTURERS

A. All equipment shall be the product of a manufacturer that has been in the business of manufacturing like product and financially stable for a period of at least five years. The Contractor shall provide equipment references as required in the request for proposals for any substitutions.
B. The Contractor shall commit, in writing, to factory support for the primary components of the DAS system, providing hardware availability and support for a minimum period of ten years following system implementation. The primary components shall include all equipment by a single or multiple manufacturers, totaling at least 70% of the capital equipment cost.

2.02 PARTS AND EQUIPMENT SPECIFICATIONS

A. Contractor shall provide parts and equipment list, and specifications for all components of the system, including:
   1. Kenwood rack mount repeaters, head end equipment.
   2. Interior Antennas.
   3. Exterior antennas.
   4. Four channel coaxial hybrid combiner and terminators.
   5. Hybrid coupler.
   6. Shielded Coaxial Cable and connectors.
   7. Lightning arrester.

2.03 REPEATER

A. Frequency range: 450-520 MHz.
B. One repeater for each channel up to four-channel.
C. Technology:
   1. Digital/analog repeater with channel filtering.
D. Input and output impedance: 50 ohms.
E. Enclosure: NEMA 4.
F. Additional outputs: System shall have alarm output.
G. Repeater shall include re-tunable or replaceable filters to accommodate pass band changes. The use of non-adjustable and non-replaceable RF duplexer filters is prohibited.

2.04 ANTENNAS

A. Exterior Antenna: Per site requirement.
B. Interior Omni-directional antenna: Per site requirement.

2.05 HYBRID COMBINERS AND COUPLERS

A. It shall cover entire RF range and provide power split ratio proper for balancing the signal strength through the signal distribution network.

2.06 WIRING AND CABLES

A. Coax: 1/2” coax transmission line.
   1. Jack material: PE.
   2. Outer conductor material: Corrugated copper.
   3. Dielectric material: Foam PE.
   4. Inner conductor material: Copper-clad aluminum wire.
   5. Jacket color: Black.
   6. Cable shall be plenum rated.

2.07 LIGHTNING PROTECTION DEVICE

A. Provide lightning protection equipment on cabling entering the building from the exterior antenna. Ground antenna to building grounding system

2.08 SPARE MATERIALS

A. Furnish spare materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Provide not less than one of each item listed below. Deliver extra materials to Owner.
   1. Antennas: One of each type installed.
   2. Passive Components (taps, combiners, splitters, couplers, etc.): One of each type installed.
   3. Cable: 100 feet (30 m); each type used
   4. Jumper Cables: Two for every type installed.

PART 3 - EXECUTION

3.01 INSTALLATION

A. The installation shall be performed by a company that has been in the business of installing DAS systems for a period of at least three years.

3.02 COORDINATION

A. Design coordination is required for this Work. Coordination with General Contractor and the design team is required to address system integration and structure cabling design.
B. Coordinate Work of this Section with on-site General Contractor and their sub-contractors.
C. Coordinate layout and installation of distributed antenna system equipment and antenna cable with other construction that penetrates ceilings or is supported by them, including but not limited to light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.
D. Coordinate locations of any equipment that differs from that shown on the Construction Documents with the Engineer and Owner prior to installation. All difference shall be clearly, noted in the submittals. Special consideration shall be taken to install antennas in areas with the least visual impact. All cabling shall be concealed wherever possible and adequately supported.
E. Coordinate installation and system level measurement with engineer, Owner, vendors and installation contractors.

3.03 CABLE INSTALLATION

A. Coaxial cable, and other associated cable and wiring shall be installed in sleeves indicated on the Construction Documents for antenna system. Provide proper support for all cabling. Cabling shall be installed in a neat and workmanlike manor. Any cabling deemed by the Engineer to be improperly installed or improperly supported shall be fixed by the Contractor at no expense to the Owner. Provide j-hooks where cable trays are not present and install cabling in conduit where installed in exposed finished areas.
B. Coaxial cables are to be terminated at bulkheads in each designated equipment room. Provide proper grounding on each bulkhead.
C. Contractor will provide as-built documentation of the installed cable system.

3.04 IDENTIFICATION

A. Comply with Division 26 Section "Identification for Electrical Systems."
B. All installed cable shall be labeled "INTERNAL RADIO DISTRIBUTED ANTENNA SYSTEM CABLE "every twenty feet.

3.05 FIELD QUALITY CONTROL

A. Contractor shall provide detailed documentation specifying test procedures for installed cabling, antennas, repeaters, coverage, and management system.
B. Perform the following field adjustments, tests, and inspections and prepare test reports:
    1. Perform operational-system tests to verify compliance with the Specifications and make adjustments to bring system into compliance.
C. Remove and replace malfunctioning units and retest.
D. Provide copies of test results to the Engineer.

3.06 PROTECTION

A. Protect finished installation until final acceptance of the project.

3.07 DEMONSTRATION

A. Provide training to Owner's representative. Provide 2 hours of training. Refer to Division 01 Section "Demonstration and Training".

3.08 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who has completed installation of

distributed antenna systems similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance. Contractor or installer will provide.

END OF SECTION

SECTION 28 31 29
AREA OF REFUGE/RESCUE ASSISTANCE SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Area of refuge/rescue assistance emergency communication system and associated call stations, control stations, and accessories.

1.02 RELATED REQUIREMENTS

A. Section 07 84 00 - Firestopping.
B. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
C. Section 26 05 34 - Conduit for Electrical Systems.
D. Section 26 05 53 - Identification for Electrical Systems.

1.03 REFERENCE STANDARDS

A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.
B. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
C. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
D. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
F. NFPA 72 - National Fire Alarm and Signaling Code; 2016.
G. NFPA 101 - Life Safety Code; 2015.
H. UL 924 - Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment or other potential obstructions within the spaces dedicated for area of refuge/rescue assistance system components.
   2. Coordinate the work with other installers to provide communication lines required for control station timed automatic connection to designated constantly attended monitoring location.
   3. Notify Engineer of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
B. Sequencing:
   1. Do not install call stations and control station(s) until final surface finishes and painting are complete.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each system component. Include configurations, standard wiring diagrams, dimensions, finishes, service condition requirements, and installed features.
C. Shop Drawings: Include plan views indicating locations of system components and proposed size, type, and routing of conduits and/or cables. Include system interconnection schematic diagrams.
D. Design Data: Include standby battery calculations.
E. Maintenance contracts.

1.06 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition

to the requirements listed below.

B. Comply with the following:

1. ADA Standards.
2. NFPA 70 (National Electrical Code).
3. The requirements of the local authorities having jurisdiction.
4. Applicable TIA/EIA standards.

C. Manufacturer Qualifications: Company engaged in manufacturing the products specified in this section with minimum three years documented experience.

D. Installer Qualifications: Company with minimum three years documented experience with similar area of refuge/rescue assistance systems and providing contract maintenance service as a regular part of their business; manufacturer's authorized installer.

E. Maintenance Contractor Qualifications: Same entity as installer.

F. Products: Listed, classified, and labeled as suitable for the purpose intended.

G. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

B. Store products in manufacturer's unopened packaging, keep dry and protect from damage until ready for installation.

1.08 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.09 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Provide minimum one year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Area of Refuge/Rescue Assistance Communication System:
1. Basis of Design: Rath Microtech, model(s) as indicated on plans.
2. Subject to compliance with specified requirements of the section and prior approval, one of the following:
   a. Cornell Communications: www.cornell.com
   b. Code Blue: www.codeblue.com
   c. Alpha Communications; www.alphacommunications.com

B. Products other than basis of design are subject to compliance with specified requirements and prior approval of Engineer. By using products other than basis of design, Contractor accepts responsibility for costs associated with any necessary modifications to related work, including any design fees.

C. Source Limitations: Furnish system components and accessories produced by a single manufacturer and obtained from a single supplier.

2.02 AREA OF REFUGE/RESCUE ASSISTANCE COMMUNICATION SYSTEM

A. Provide new area of refuge/rescue assistance communication system consisting of all required equipment, conduit, boxes, wiring, connectors, hardware, accessories, system programming, etc. as necessary for a complete operating system that provides the functional intent indicated.

B. System Description:
1. Call Stations: Located at each designated area of refuge/rescue assistanceas indicated on drawings, unless otherwise directed by authorities having jurisdiction.
2. Master Control Station: New, located as indicated on drawings, unless otherwise directed by authorities having jurisdiction.
3. System battery backup is required.

4. Timed automatic connection to designated constantly attended monitoring location is required.

C. System Operation:

1. When a call for assistance is initiated at call station:
    a. Provide audible and visual notification at call station to confirm that call has been placed.
    b. Provide audible and visual notification at control station(s) that call has been placed and annunciate the location of the call station/zone that initiated a call.
    c. Maintain visual notification of each call location at control station(s) until manually reset by control station operator.
    d. Maintain audible notification at control station(s) that call(s) have been placed until call is acknowledged by control station operator.
    e. Maintain visual notification at call station until manually reset by control station operator.
2. When a call for assistance is acknowledged at control station:
    a. Provide visual notification at control station that call has been acknowledged.
    b. Provide visual notification at call station that call has been received.
    c. Establish two-way voice communication between call station and control station.
3. When a call has not been acknowledged during a programmed time delay to allow for local response, automatically initiate call to listed remote monitoring station under contract with facility and establish two-way voice communication.

D. Call Station(s):
1. Suitable for the environment where installed.
2. Finish: Stainless steel.
3. Mounting: Flush-mounted.
4. Button engraved: PUSH FOR HELP.
5. Provides means to initiate call for assistance.
6. Provides for distinct audible and visual notification to confirm that call has been placed and for distinct visual notification that call has been acknowledged.
7. Following initial call for assistance, provides for hands-free two-way communication with control station(s).

E. Control Station(s):
1. Suitable for the environment where installed.
2. Mounting: As indicated on drawings.
3. Provides visual notification that system is operational.
4. Provides for distinct audible and visual notification of calls with annunciation of call station/zone locations.
5. Provides for two-way communication with selected call stations.
6. Provides for supervision of system wiring and provides distinct audible and visual notification of faults.
7. Audible Notification Sound Level: Not less than 90 dB.

F. Accessories:
1. Provide components as indicated or as required for a complete operating system.
2. Wiring: Provide manufacturer's recommended cables as indicated or as required for connections between system components, and in accordance with wiring methods indicated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.
B. Verify that characteristics of system components are consistent with the indicated requirements.
C. Verify that mounting surfaces are ready to receive system components.
D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).

B. Install products in accordance with manufacturer's instructions.
C. Mounting Heights:
    1. Call Stations: Comply with applicable accessibility requirements.
    2. Control Stations: As indicated on drawings.
D. Wiring Method:
    1. Use listed plenum rated cables in spaces used for environmental air.
    2. Install wiring in conduit where required for rough-in, where required by authorities having jurisdiction, and where exposed to damage.
    3. Conduit: Comply with Section 26 05 34.
E. Provide grounding and bonding in accordance with Section 26 05 26.
F. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.
G. Identify system wiring and components in accordance with Section 26 05 53.
H. Identify zones at control station(s) to indicate call station locations.
I. Provide required instructional signage at each call station.

3.03 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.
B. Test to verify wiring is free of shorts and grounds.
C. Prepare and start system in accordance with manufacturer's instructions.
D. Test system for proper operation.
E. Correct defective work, adjust for proper operation, and retest until entire system complies with contract documents.
F. Submit detailed reports indicating inspection and testing results and corrective actions taken.

3.04 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.05 CLOSEOUT ACTIVITIES

A. Demonstration: Demonstrate proper operation of system to Owner, and correct deficiencies or make adjustments as directed.
B. Training: Train Owner's personnel on operation, adjustment, and maintenance of system.
    1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
    2. Provide minimum of two hours of training.
    3. Instructor: Manufacturer's authorized representative.
    4. Location: At project site.

3.06 PROTECTION

A. Protect installed system components from subsequent construction operations.

3.07 MAINTENANCE

A. Provide to Owner, a proposal as an alternate to the base bid, a separate maintenance contract for the service and maintenance of area of refuge/rescue assistance system for one year from date of Substantial Completion; Include a complete description of preventive maintenance, systematic examination, adjustment, cleaning, inspection, and testing, with a detailed schedule.
B. Provide trouble call-back service upon notification by Owner:
    1. Include allowance for call-back service during normal working hours at no extra cost to Owner.
    2. Owner will pay for call-back service outside of normal working hours on an hourly basis, based on actual time spent at site and not including travel time; include hourly rate and definition of normal working hours in maintenance contract.

END OF SECTION

SECTION 31 1000

SITE CLEARING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Protecting existing vegetation to remain.
   2. Removing existing vegetation.
   3. Clearing and grubbing.
   4. Stripping and stockpiling topsoil.
   5. Removing above- and below-grade site improvements.
   6. Disconnecting, capping or sealing, and removing site utilities and abandoning site utilities in place.
   7. Temporary erosion- and sedimentation-control measures.

1.02 RELATED SECTIONS

A. Section 00 31 00 – Available Information.

B. Section 02 41 00 - Selective Site Demolition.

1.03 DEFINITIONS

A. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

B. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.

C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil and is the zone where plant roots grow. Its appearance is generally friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches (50 mm) in diameter; and free of subsoil and weeds, roots, toxic materials, or other nonsoil materials.

D. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, and indicated on Drawings.

E. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and indicated on Drawings.

F. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.04 MATERIAL OWNERSHIP

A. Except for stripped topsoil and other materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.05 SUBMITTALS

A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.
   1. Use sufficiently detailed photographs or videotape.
   2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.

B. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.06 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.

C. Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant-protection measures are in place.

D. Soil Stripping, Handling, and Stockpiling: Perform only when the topsoil is dry or slightly moist.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Satisfactory Soil Material: Refer to Section 31 23 00 Excavation and Fill. If materials are not indicated there, refer to Soils Report and Coordinate with Architect.
1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.
2. Contractor to provide documentation that all imported materials are environmentally clean.

PART 3 - EXECUTION

3.01 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.
1. Locate and clearly identify trees, shrubs, and other vegetation to remain. Flag each tree trunk at 54 inches (1372 mm) above the ground.

B. Protect existing site improvements to remain from damage during construction.
1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.02 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.

B. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.

C. Remove erosion and sedimentation controls with approval from the AHJ and restore and stabilize areas disturbed during removal

3.03 TREE AND PLANT PROTECTION

A. Protect existing trees and plants to remain by marking and enforcing landscape protection areas.
1. Size construction limits as recommended for size and type of plant.
2. Do not dig, store materials, pile earth, drive or park vehicles within the limits.
3. See Section 31 23 00 for more requirements for landscape protection areas.

B. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Architect/Engineer.

3.04 EXISTING UTILITIES

A. Owner will arrange for disconnecting and sealing indicated utilities that serve existing structures before site clearing, when requested by Contractor.
1. Verify that utilities have been disconnected and capped before proceeding with site clearing.

B. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.
1. Arrange with utility companies to shut off indicated utilities.

C. Locate, identify, and disconnect utilities indicated to be abandoned in place.

D. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
   1. Notify Architect not less than 2 days in advance of proposed utility interruptions.
   2. Do not proceed with utility interruptions without Architect's/Engineer's written permission.

E. Excavate for and remove underground utilities indicated to be removed.

3.05 CLEARING AND GRUBBING

A. Install Phase I Erosion and Sediment Controls prior to any land disturbing activities.

B. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.
   1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
   2. Grind down stumps and remove roots, obstructions, and debris to a depth of 18 inches (450 mm) below exposed subgrade.
   3. Use only hand methods for grubbing within protection zones.

C. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
   1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches (200 mm), and compact each layer to a density equal to adjacent original ground.

3.06 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to depth indicated on Drawings or to a minimum depth of 6 inches (150 mm) in a manner to prevent intermingling with underlying subsoil or other waste materials.
   1. Remove subsoil and non-soil materials from topsoil, including clay lumps, gravel, and other objects more than 2 inches (50 mm) in diameter; trash, debris, weeds, roots, and other waste materials.

C. Stockpile topsoil away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.
   1. Height of topsoil stockpiles not to exceed 72 inches (1800 mm) unless approved otherwise in advance.
   2. Do not stockpile topsoil within protection zones.
   3. Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or reused.
   4. Stockpile surplus topsoil to allow for respreading deeper topsoil.

3.07 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated and as necessary for all new construction.
   1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.
   2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

3.08 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

B. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities. Do not interfere with other Project work.

C. Comply with all federal, state and local regulations associated with disposal of material removed from the site.

END OF SECTION

SECTION 31 1123

AGGREGATE BASE

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools and services required to fully complete all Aggregate Base work as required by the Drawings and/or specified herein including, but not limited to, the following described items:
   1. Aggregate Base for:
      a. Interior concrete slabs-on-grade.
      b. Miscellaneous exterior concrete (sidewalks, curb, gutter and equipment pads).
      c. Asphalt paving.
      d. Concrete paving.

1.02 RELATED REQUIREMENTS:

A. Section 01 1200: 'Multiple Contract Summary' for multiple contracts.

B. Section 01 4523: 'Testing and Inspecting Services' for testing and inspection, and testing laboratory services for materials, products, and construction methods.

C. Section 03 3000: 'Cast-In-Place Structural Concrete'.
   1. Furnishing of vapor retarder and seam tape.

D. Section 31 0501: 'Common Earthwork Requirements':
   1. General procedures and requirements for earthwork.
   2. Pre-installation conference held jointly with other common earthwork related sections.
   3. Section 31 2213: 'Rough Grading'.
   4. Section 31 2216: 'Fine Grading' for subgrade procedures.
   5. Section 31 2323: 'Fill' for compaction procedures and tolerances.
   6. Section 31 3116: 'Termite Control'. (If used)
   7. Section 32 1216: 'Asphalt Paving.
   8. Section 32 1313: 'Concrete Paving'.

E. Products Installed But Not Furnished Under This Section:
   1. Vapor Retarder:
      a. Interior slabs on grade:
         1) Under-slab vapor retarder and seam tape.

1.03 DEFINITIONS:

A. Aggregate (Asphalt Paving):
   1. Aggregate: A hard inert mineral material, such as gravel, crushed rock, slag, or sand.
   2. Coarse Aggregate: Aggregate retained on No. 8 (2.36 mm) sieve.
   3. Dense-Graded Aggregate: Aggregate that is graded from maximum size down through filler with object of obtaining an asphalt mix with controlled void content and high stability.
   4. Fine Aggregate: Aggregate passing No. 8 (2.36 mm) sieve.
   5. Reclaimed Asphalt Pavement (RAP): Existing asphalt mixture that has been pulverized, usually by milling, and is used like an aggregate in recycling of asphalt pavements.
   6. Gravel (Concrete Paving):
      a. Gravel: Material passing 75-mm (3-inch) sieve and retained on 4.75-mm (No. 4) sieve.

b. Coarse Gravel: Material passing 75-mm (3-inch) sieve and retained on 19.0-mm (3/4-inch) sieve.
c. Fine Gravel: Material passing 19.0-mm (3/4-inch) sieve and retained on 4.75-mm (No. 4) sieve.
d. Maximum Size (of aggregate) - in specifications for, or description of aggregate, smallest sieve opening through which entire amount of aggregate is required to pass.
e. Nominal Maximum Size (of aggregate) - in specifications for, or description of aggregate, smallest sieve opening through which entire amount of aggregate is permitted to pass.

7. Sand (Concrete Paving):
a. Sand: Material passing 4.75-mm sieve (No. 4) and retained on 0.075-mm (No. 200) sieve.
b. Coarse Sand: Material passing 4.75-mm sieve (No. 4) and retained on 2.00-mm (No. 10) sieve.
c. Medium Sand: Material passing 2.00-mm sieve (No. 10) and retained on 0.475-mm (No. 40) sieve.
d. Fine Sand: Material passing 0.475-mm (No. 40) sieve and retained on 0.075-mm (No. 200) sieve.
e. Maximum Size (of aggregate) - in specifications for, or description of aggregate, smallest sieve opening through which entire amount of aggregate is required to pass.
f. Nominal Maximum Size (of aggregate) - in specifications for, or description of aggregate, smallest sieve opening through which entire amount of aggregate is permitted to pass.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conferences:
1. Participate in MANADORY pre-installation conference as specified in Section 31 0501.
2. In addition to agenda items specified in Section 01 3100 and Section 31 0501, review following:
a. Review requirements and frequency of testing and inspections.
b. Review termite control application requirements. (if used)
c. Review aggregate base installation requirements.
d. Review vapor retarder installation requirements.
e. Review proposed miscellaneous exterior concrete schedule.
f. Review proposed asphalt paving schedule.
g. Review proposed concrete paving schedule.
h. Review Section 01 4523 for Testing and Inspection administrative requirements and responsibilities and Field Quality Control tests and inspections required of this section.
1) Review frequency of testing and inspections.

B. Sequencing:
1. Compaction as described in Section 31 2216 'Fine Grading'.
2. Termite Control: (if used)
a. Termite application as described in Section 31 3116 ‘Termite Control’:
1) Application OPTION A:
(a) Apply termite protection on top of soil base before aggregate base and vapor retarder is installed.
2) Application OPTION B:
(a) Install vapor retarder after application of termite protection on top of aggregate base.
3. Exterior Footings and Foundations are installed.
4. Vapor Retarder below interior concrete slabs on grade:
a. Install below-grade vapor retarder on top of aggregate base.

5. Aggregate Base:
    a. Install aggregate base at location shown in Contract Drawings.
6. Concrete Slab is installed.

C. Scheduling:
1. Interior slab-on-grade concrete:
    a. Notify Architect twenty-four (24) hours minimum before installation of concrete to allow inspection of vapor retarder installation.
    b. Notify Testing Agency and Architect twenty-four (24) hours minimum before installation of interior concrete slabs to allow inspection of aggregate base.
    c. Allow special inspector to review all sub grades and excavations to determine if building pad has been prepared in accordance with geotechnical report prior to placing any aggregate base.
2. Miscellaneous exterior concrete:
    a. Notify Testing Agency and Architect twenty-four (24) hours minimum before placing concrete for exterior site work concrete (sidewalks, curbs, gutters, etc.), footings, foundation walls, and building slabs to allow inspection of aggregate base.
3. Asphalt Paving:
    a. Notify Testing Agency and Architect twenty-four (24) hours minimum before placing aggregate base to allow inspection of aggregate base.
4. Concrete Paving:
    a. Notify Testing Agency and Architect twenty-four (24) hours minimum before placing aggregate base to allow inspection of aggregate base.

1.05 SUBMITTALS

A. Closeout Submittals:
1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
    a. Record Documentation:
        1) Testing and Inspection Reports:
            (a) Testing Agency Testing and Inspecting Reports of aggregate base.

1.06 QUALITY ASSURANCE

A. Testing And Inspection:
1. Owner will provide Testing and Inspection for aggregate base:
    a. Owner is responsible for Quality Assurance. Quality assurance performed by Owner will be used to validate Quality Control performed by Contractor.
    b. Owner will employ testing agencies to perform testing and inspection for aggregate base as specified in Field Quality Control in Part 3 of this specification.
        1) Owner's employment of an independent Testing Agency does not relieve Contractor of Contractor's obligation to perform the Work in strict accordance with requirements of Contract Documents and perform contractor testing and inspection.
        2) See Section 01 1200: 'Multiple Contract Summary'.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Delivery And Acceptance Requirements:
1. Materials shall be delivered in original, unopened packages with labels intact.

1.08 FIELD CONDITIONS

A. Ambient Conditions:
1. Do not perform work during unfavorable conditions as specified below:
    a. Aggregate Base:

1) Presence of free surface water.
2) Over-saturated sub base materials.
3) Presence of frost within sub base materials.

b. Vapor Retarder:
1) Unacceptable conditions for installation include presence of high winds which would tear or damage vapor retarder.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Aggregate Base:
1. Under Interior Slab-On-Grade Concrete (Section 03 3000 'Cast-In-Place Structural Concrete'):
a. New Aggregate Base:
1) Gravel: 3/4 inch 18mm minimum to one inch 25 mm maximum well-graded, clean gravel or crushed rock.
2) Base type gravel or crushed rock, graded by weight as follows (three-quarter to one-inch clean gap-graded gravel):
(a) Road Base type gravel or crushed stone (slag not allowed), graded as follows:

Sieve		Percent of Weight Passing
1 inch	(25.4 mm)	100
3/4 inch	(19.0 mm)	90 - 80
1/2 inch	(12.7 mm)	20 - 40
3/8 inch	(9.5 mm)	5 - 10
No. 4	(4.750 mm)	0 - 12

2. Under Exterior Concrete (Section 03 3000 'Cast-In-Place Structural Concrete') excluding Concrete Paving:
a. New Aggregate Base:
1) Road Base to conform to State DOT Specifications.
3. Under Asphalt Paving (Section 32 1216 'Asphalt Paving'):
a. Aggregate Base:
1) Road Base to conform to 1-1/2 inches (38 mm) minus State DOT Specifications and Gradations.
2) Aggregate base shall be non-plastic.
3) Road Base to be placed over properly prepared Subbase Material according to Section 31 2000.
4. Under Concrete Paving (Section 32 1313 'Concrete Paving'):
a. Aggregate Base:
1) Road Base to conform to 1-1/2 inches (38 mm) minus State DOT Specifications and Gradations.
2) Aggregate base shall be non-plastic.
3) Road Base to be placed over properly prepared Subbase Material according to Section 31 2000.

PART 3 - EXECUTION

3.01 PREPARATION

A. Stockpiles:
1. Provide area for each stockpile of adequate size, reasonably uniform in cross-section, well drained, and cleared of foreign materials.
2. Locate piles so that there is no contamination by foreign material and no intermingling of aggregates from adjacent piles. Do not use steel-tracked equipment on stockpiles.

3. Do not store aggregates from different sources, geological classifications, or of different gradings in stockpiles near each other unless bulkhead is placed between different materials.
4. Do not use washed aggregates sooner than twenty-four (24) hours after washing or until surplus water has drained out and material has uniform moisture content.
5. Do not stockpile higher than 15 feet (4.57 m). Cover or otherwise protect stockpiles for use in HMA to prevent buildup of moisture.
6. Use established Best Management Practices for dust and erosion control.

B. Surface Preparation (Miscellaneous Exterior Concrete):
1. Subgrade:
a. Finish grade to grades required by Contract Documents.
b. Compact subgrade as specified in Section 31 2323.

C. Surface Preparation (Asphalt Paving):
1. Subgrade:
a. Finish grade parking surface area to grades required by Contract Documents.
b. Aggregate sub base, base and paving must be placed before any moisture or seasonal changes occur to subgrade that would cause compaction tests previously performed to be erroneous. Recompact and retest subgrade soils that have been left exposed to weather.

D. Surface Preparation (Concrete Paving):
1. Subgrade:
a. Finish grade parking surface area to grades required by Contract Documents.
b. Aggregate sub base, base and paving must be placed before any moisture or seasonal changes occur to subgrade that would cause compaction tests previously performed to be erroneous. Recompact and retest subgrade soils that have been left exposed to weather.

E. Surface Preparation (Interior Slab-On-Grade Concrete):
1. Vapor Retarder:
a. Install vapor retarder in accordance with ASTM E1643 except where Contract Documents indicate otherwise and following instructions:
1) Install vapor retarder over aggregate base over compacted subgrade so entire area under slab is covered.
2) Install vapor retarder in accordance with ASTM E1643 at interior stem walls.
3) Lap joints 6 inches (150 mm) minimum and seal with specified seam tape.
4) Seal vapor retarder around pipes, conduits, and other utility items that penetrate vapor retarder using factory-fabricated boot installed as recommended by Manufacturer.
5) Except for punctures required for reinforcing and anchor bolts at top of stem walls, seal tears and punctures.

3.02 INSTALLATION

A. Aggregate Base:
1. General:
a. Do not place aggregate sub base, base material when subgrade is frozen or unstable.
b. Spread aggregate sub base and base material with equipment except in limited or restricted areas where use of hand spreading is allowed.
c. Spread aggregate sub base and base material in manner that does not break down material and eliminates segregation, ruts, and ridges.
d. Correct damage to aggregate sub base and base caused by construction activities and maintain corrected aggregate base until subsequent course is placed.

e. Do not allow traffic on aggregate base.
f. Remove all standing storm water.

2. Under interior concrete slab-on-grade aggregate base (Contractor Option):
   a. Place 4 inches (100 mm) minimum of aggregate base under vapor retarder, level, and compact with two passes of 2 1/2 ton (2.54 metric ton) minimum roller.
   b. Place 4 inches (100 mm) minimum of aggregate base under vapor retarder, level, and compact with vibratory plate compactor.
3. Under miscellaneous exterior concrete aggregate base:
   a. Except under mow strips, place 4 inches (100 mm) minimum of aggregate base, level, and compact as specified in Section 31 2323.
4. Asphalt paving aggregate sub base and base:
   a. Install minimum thickness sub base and base after compaction in accordance with Contract Drawings.
   b.
   c. Compact as specified in Section 31 2323.
   d. Priming: Prime aggregate base with application of 0.2 to 0.5 gallons (2 to 5 liters) of asphalt cement primer per square yard (meter) if pavement will be laid more than three days after compaction of aggregate base, or if precipitation is anticipated between completion of compaction of aggregate base and laying of asphalt paving.
   e. Recompact unprimed aggregate base if it receives precipitation before pavement is laid.
   f. Remove or repair improperly prepared areas as directed by Architect.
5. Concrete paving aggregate sub base and base:
   a. Install minimum thickness sub base and base after compaction in accordance with Contract Drawings.
   b. Compact as specified in Section 31 2323.
      d. Remove or repair improperly prepared areas as directed by Architect.

B. Tolerances:
   1. Asphalt Paving Areas:
      a. Aggregate sub base and base:
         1) Measure using string line from curb to curb, gutter, flat drainage structure, or grade break.
         2) Finished sub base course shall be true to line and grade within plus or minus ½ inch in 10 feet (12mm in 3 meters).
         3) Finished base course shall be true to line and grade within plus or minus 1/4 inch in 10 feet (6 mm in 3 meters).
         4) Maximum variation from required grades shall be 1/10 of one foot (28 mm).
      b. Concrete Paving Areas:
         1) Measure using string line from curb to curb, gutter, flat drainage structure, or grade Measure using string line from curb to curb, gutter, flat drainage structure, or grade break.
         2) Finished sub base course shall be true to line and grade within plus or minus ½ inch in 10 feet (12mm in 3 meters).
         3) Finished base course shall be true to line and grade within plus or minus 1/4 inch in 10 feet (6 mm in 3 meters).
         4) Maximum variation from required grades shall be 1/10 of one foot (28 mm).

3.03 FIELD QUALITY CONTROL

A. Field Tests And Inspections:
   1. Civil and structural field tests, laboratory testing, and inspections are provided by Owner's independent Testing Agency as specified in Section 01 4523 'Testing And Inspection Services':
      a. Quality Control is sole responsibility of Contractor.

1) Owner's employment of an independent Testing Agency does not relieve Contractor of Contractor's obligation to perform testing and inspection as part of his Quality Control:
   (a) Testing and inspections, if performed by Contractor, will be responsibility of Contractor to be performed by an independent entity.

2. Aggregate Sub Base and Base:
   a. Interior slab-on-grade concrete areas:
      1) Testing Agency shall provide testing and inspection for interior aggregate base.
      2) Number of tests may vary at discretion of Architect.
      3) Testing Agency will test compaction of base in place according to ASTM D1556/D1556M, ASTM D2167, and ASTM D6938, as applicable. Tests will be performed at following frequency:
         (a) Building Slab Areas: One test for every 2,500 sq. ft. (232 sq. m) or less of building slab area but no fewer than three tests.
   b. Miscellaneous exterior concrete areas:
      1) Testing Agency shall provide testing and inspection for exterior aggregate sub base and base.
      2) Number of tests may vary at discretion of Architect.
      3) Testing Agency will test compaction of base in place according to ASTM D1556/D1556M, ASTM D2167, and ASTM D6938, as applicable. Tests will be performed at following frequency:
         (a) Sitework Areas: One test for every 10,000 sq. ft. (930 sq. m) or less of exterior pads area but no fewer than three tests.
   c. Asphalt paving area:
      1) Testing Agency shall provide testing and inspection for exterior aggregate sub based and base.
      2) Number of tests may vary at discretion of Architect.
      3) Testing Agency will test compaction of base in place according to ASTM D1556/D1556M, ASTM D2167, and ASTM D6938, as applicable. Tests will be performed at following frequency:
      4) Sitework Areas: One test for every 10,000 sq. ft. (930 sq. m) or less of exterior paving area but no fewer than three tests.
   d. Concrete paving area:
      1) Testing Agency shall provide testing and inspection for exterior aggregate base.
      2) Number of tests may vary at discretion of Architect.
      3) Testing Agency will test compaction of base in place according to ASTM D1556/D1556M, ASTM D2167, and ASTM D6938, as applicable. Tests will be performed at following frequency:
         (a) Sitework Areas: One test for every 10,000 sq. ft. (930 sq. m) or less of exterior paving area but no fewer than three tests.

3.04 PROTECTION

A. Interior Slab-On-Grade Concrete:
   1. Vapor Retarder:
      a. Do not allow water onto vapor retarder or aggregate base before placing concrete.
      b. Protect membrane from possible punctures caused by reinforcing bar supports before placing concrete.

END OF SECTION 32 1123

SECTION 31 2213

ROUGH GRADING - SITE

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools and services required to fully complete all Rough Grading work as required by the Drawings and/or specified herein including, but not limited to, the following described items.
   1. Perform rough grading work required to prepare site for construction as described in Contract Documents.

1.02 RELATED REQUIREMENTS

A. Section 31 0501: Common Earthwork Requirements

1.03 QUALITY ASSURANCE

A. Pre-Installation Conference:
   1. Schedule conference after completion of site clearing but before beginning grading work.
   2. Identify benchmark to be used in establishing grades and review Contract Document requirements for grades, fill materials, and topsoil.
   3. Examine site to pre-plan procedures for making cuts, placing fills, and other necessary work.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Materials used for fill shall be as specified for backfill in Section 31 2323.

PART 3 EXECUTION

3.01 PREPARATION

A. Before making cuts, remove topsoil over areas to be cut and filled that was not previously removed by stripping specified in Section 31 1413. Stockpile this additional topsoil with previously stripped topsoil.

3.02 PERFORMANCE

A. Site Tolerances:
   1. Maximum variation from required grades shall be 6-inches.

B. Compact fills as specified in Section 31 2323.

C. If soft spots, water, or other unusual and unforeseen conditions affecting grading requirements are encountered, stop work and notify Architect.

END OF SECTION 31 2213

SECTION 31 2216

FINE GRADING - SITE

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools and services required to fully complete all Fine Grading work as required by the Drawings and/or specified herein including, but not limited to, the following described items.
   1. Perform fine grading work required to prepare site for paving finish grading and for landscape finish grading and soil preparation as described in Contract Documents.

1.02 RELATED REQUIREMENTS

A. Section 31 0501: Common Site Construction Requirements.

B. Section 31 1413: Stripping and storing of existing topsoil.

C. Section 32 1216: Finish grading for asphalt paving.

D. Section 32 1313: Finish grading for concrete paving.

1.03 QUALITY ASSURANCE

A. Pre-Installation Conference: Participate in pre-installation conference specified in Section 31 2213.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.01 EXAMINATION

A. Do not commence work of this Section until grading tolerances specified in Section 31 2213 are met.

3.02 PREPARATION

A. Protection: Protect utilities and site elements from damage.

B. Surface Preparation:
   1. Before grading, dig out weeds from planting areas by their roots and remove from site. Remove rocks larger than 2-inches in size and foreign matter such as building rubble, wire, cans, sticks, concrete, asphalt, etc.
   2. Remove imported paving base material present in planting areas down to natural subgrade or other material acceptable to Architect.
   3. Limit use of heavy equipment to areas near buildings and other permanent structures.

3.03 PERFORMANCE

A. Site Tolerances:

B. Maximum variation from required grades shall be $1/10^{th}$ of one foot.

C. Do not expose or damage existing shrub or tree roots.

D. Redistribute approved existing topsoil stored on site as a result of work of Section 31 1413. Remove organic material, rocks and clods greater than 1.5-inches in any dimension, and other objectionable materials.

E. Slope grade away from building for 12-feet minimum from walls at slope of 1-foot in 25 feet minimum unless otherwise noted. Direct surface drainage in manner indicated on Drawings by molding surface to facilitate natural run-off of water. Fill low spots and pockets with specified topsoil and grade to drain properly.

END OF SECTION 31 2216

SECTION 31 2300

EXCAVATION AND FILL

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Preparing subgrades for slabs-on-grade, walks, pavements, turf and grasses, and plants.
   2. Excavating and backfilling for buildings and structures.
   3. Drainage course for concrete slabs-on-grade.
   4. Subbase course for concrete walks and pavements.
   5. Aggregates.
   6. Subbase course for asphalt paving.
   7. Subsurface drainage backfill for walls and trenches.
   8. Excavating and backfilling trenches for utilities and pits for buried utility structures.

1.02 RELATED SECTIONS

A. Section 00 31 00 – Available Project Information: Geotechnical Report.

B. Section 31 10 00 - Site Clearing.

1.03 UNIT PRICES

A. Aggregate Materials, per cubic yard.

B. Rock Measurement: Volume of rock actually removed, measured in original position, but not to exceed the following. Unit prices for rock excavation include replacement with approved materials.
   1. 24 inches (600 mm) outside of concrete forms other than at footings.
   2. 12 inches (300 mm) outside of concrete forms at footings.

1.04 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.
   1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
   2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
   1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect/Engineer. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.
   2. Bulk Excavation: Excavation more than 10 feet (3 m) in width and more than 30 feet (9 m) in length.
   3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect/Engineer. Unauthorized excavation, as well as remedial work directed by Architect/Engineer, shall be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

H. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material 3/4 cu. yd. (0.57 cu. m) or more in volume that exceed a standard penetration resistance of 100 blows/2 inches (97 blows/50 mm) when tested by a geotechnical testing agency, according to ASTM D1586.

I. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

J. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

K. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

L. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.05 SUBMITTALS

A. Product Data: For each type of the following manufactured products required:
   1. Geotextiles.
   2. Controlled low-strength material, including design mixture.
   3. Geofoam.
   4. Warning tapes.

B. Qualification Data: For qualified testing agency.

C. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:
   1. Classification according to ASTM D2487.
   2. Laboratory compaction curve according to ASTM D698.

D. Pre-excavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earth moving operations. Submit before earth moving begins.

E. Contractor to provide delivery slips to the Architect/Engineer for materials used.

F. Contractor to provide certification that all imported materials are environmentally clean.

1.06 QUALITY ASSURANCE

A. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E329 and ASTM D3740 for testing indicated.

B. Pre-Excavation Meeting: Conduct meeting at Project site.

1.07 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth moving operations.
   1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
   2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Utility Locator Service: Notify utility locator service provider a minimum of 72 hours before beginning earth moving operations.

C. Do not commence earth moving operations until temporary erosion- and sedimentation-control measures, specified in Division 2 - Selective Site Demolition, are in place.

D. Do not commence earth moving operations until plant-protection measures specified in Division 2 Section - Selective Site Demolition are in place.

E. The following practices are prohibited within protection zones:
   1. Storage of construction materials, debris, or excavated material.
   2. Parking vehicles or equipment.
   3. Foot traffic.
   4. Erection of sheds or structures.

5. Impoundment of water.
6. Excavation or other digging unless otherwise indicated.
7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

F. Do not direct vehicle or equipment exhaust towards protection zones.

G. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials imported to the site are to be environmentally clean. Contractor to maintain manifest of all materials imported on to the site.

2.02 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, and SM according to ASTM D2487, or a combination of these groups; free of rock or gravel larger than 3 inches (75 mm) in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D2487 or a combination of these groups.
1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940; with at least 90 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve.

E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940; with at least 95 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.

F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940; with at least 90 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve.

G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940; except with 100 percent passing a 1-inch (25-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.

H. Drainage Course: Narrowly graded mixture of washed crushed stone, or crushed or uncrushed gravel; ASTM D448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch (37.5-mm) sieve and 0 to 5 percent passing a No. 8 (2.36-mm) sieve.

I. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch (25-mm) sieve and 0 to 5 percent passing a No. 4 (4.75-mm) sieve.

J. Sand: ASTM C33; fine aggregate.

K. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.03 GEOTEXTILES

A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
1. Survivability: Class 2; AASHTO M 288.
2. Apparent Opening Size: No. 40 (0.425-mm) sieve, maximum; ASTM D4751.
3. Permittivity: 0.5 per second, minimum; ASTM D4491.

2.04 CONTROLLED LOW-STRENGTH MATERIAL

A. Controlled Low-Strength Material: Self-compacting, low-density, flowable concrete material produced from the following:
   1. Portland Cement: ASTM C150, Type I.
   2. Fly Ash: ASTM C618, Class C or F.
   3. Normal-Weight Aggregate: ASTM C33, 3/4 inch (19-mm) nominal maximum aggregate size.

B. Produce conventional-weight, controlled low-strength material with 80 psi (550-kPa) compressive strength when tested according to ASTM C495.

2.05 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility; colored as follows:
   1. Red: Electric.
   2. Yellow: Gas, oil, steam, and dangerous materials.
   3. Orange: Telephone and other communications.
   4. Blue: Water systems.
   5. Green: Sewer systems.

PART 3 - EXECUTION

3.01 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.

B. Protect and maintain erosion and sedimentation controls during earth moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.02 DEWATERING

A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
   1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

3.03 EXPLOSIVES

A. Explosives: Do not use explosives.

3.04 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.
   1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
   2. Remove rock to lines and grades indicated to permit installation of permanent construction without exceeding the following dimensions:
      a. 24 inches (600 mm) outside of concrete forms other than at footings.
      b. 12 inches (300 mm) outside of concrete forms at footings.
      c. 6 inches (150 mm) outside of minimum required dimensions of concrete cast against grade.
      d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
      e. 6 inches (150 mm) beneath bottom of concrete slabs-on-grade.

f. 6 inches (150 mm) beneath pipe in trenches, and the greater of 24 inches (600 mm) wider than pipe or 42 inches (1065 mm) wide.

3.05 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch (25 mm). If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
   1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
   2. Pile Foundations: Stop excavations 6 to 12 inches (150 to 300 mm) above bottom of pile cap before piles are placed. After piles have been driven, remove loose and displaced material. Excavate to final grade, leaving solid base to receive concrete pile caps.
   3. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch (25 mm). Do not disturb bottom of excavations intended as bearing surfaces.

B. Excavations at Edges of Tree- and Plant-Protection Zones:
   1. Excavate by hand to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
   2. Cut and protect roots according to requirements in Division 2 Section "Tree Protection and Trimming."

3.06 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.07 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.
   1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches (300 mm) higher than top of pipe or conduit unless otherwise indicated.
   1. Clearance: 12 inches (300 mm) each side of pipe or conduit.

C. Trench Bottoms: Excavate trenches 4 inches (100 mm) deeper than bottom of pipe and conduit elevations to allow for bedding course. Hand-excavate deeper for bells of pipe.

D. Trenches in Tree- and Plant-Protection Zones:
   1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
   2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.
   3. Cut and protect roots according to requirements in Division 2 Section "Tree Protection and Trimming."

3.08 SUBGRADE INSPECTION

A. Notify Project Manager when excavations have reached required subgrade.

B. If Project Manager determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

C. Proof-roll subgrade below the building slabs and pavements with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons (13.6 tonnes) to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
   1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph (5 km/h).

2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Project Manager, and replace with compacted backfill or fill as directed.
3. Proof roll subgrade under area of porous pavement in accordance with porous pavement manufacturer's recommendations

D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.

E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Project Manager, without additional compensation.

3.09 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi (17.2 MPa), may be used when approved by Project Manager.
1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Project Manager.

3.10 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.
2. Provide filter fabric fencing around stock pile areas.

3.11 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:
1. Construction below finish grade including, where applicable, subdrainage, damp-proofing, waterproofing, and perimeter insulation.
2. Surveying locations of underground utilities for Record Documents.
3. Testing and inspecting underground utilities.
4. Removing concrete formwork.
5. Removing trash and debris.
6. Removing temporary shoring and bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.12 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow and ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Trenches under Footings: Backfill trenches excavated under footings and within 18 inches (450 mm) of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Division 3 Section Cast-in-Place Concrete.

D. Trenches under Roadways: Provide 4-inch- (100-mm-) thick, concrete-base slab support for piping or conduit with less than 18" of cover below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches (100 mm) of concrete before backfilling or placing roadway subbase course. Concrete is specified in Division 3 Section Cast-in-Place Concrete.

E. Backfill voids with satisfactory soil while removing shoring and bracing.

F. Place and compact initial backfill of subbase material, free of particles larger than 1 inch (25 mm) in any dimension, to a height of 12 inches (300 mm) over the pipe or conduit.

1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

G. Place and compact final backfill of satisfactory soil to final subgrade elevation.

H. Controlled Low-Strength Material: Place final backfill of controlled low-strength material to final subgrade elevation.

I. Install warning tape directly above utilities, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

3.13 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:
1. Under grass and planted areas, use satisfactory soil material.
2. Under walks and pavements, use satisfactory soil material.
3. Under steps and ramps, use engineered fill.
4. Under building slabs, use engineered fill.
5. Under footings and foundations, use engineered fill.

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.14 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.15 COMPACTION OF SOIL BACKFILLS AND FILLS

A. All fill and backfill in structural areas, such as building, parking deck, pavement, and sidewalk areas, should be placed in maximum nine-inch loose lifts and compacted to 93 percent of the maximum dry density within two percent of the optimum moisture content as determined by ASTM D 1557 (Modified Proctor).

B. Fill placed within landscaped areas may be placed and compacted to 85 percent of the maximum dry density within three percent of the optimum moisture content as determined by ASTM D 1557 (Modified Proctor).

C. A sheep's foot roller shall be used to compact the on-site soils or a small hand-held vibratory compactor within excavations.

3.16 STRUCTURAL FILL TESTING

A. Before filling operations begin, representative samples of each proposed fill material shall be collected. The samples shall be tested to determine the maximum dry density, optimum moisture content, natural moisture content, gradation, and plasticity of the soil prior to construction in order to avoid construction delays. These tests are needed for quality control during compaction, and also to determine if the fill material is acceptable.

B. The placement of fill and backfill shall be monitored by a qualified engineering technician to ensure that the specified material and lift thicknesses are properly installed. The following frequency of in-place density tests shall be performed to ensure that the specified compaction is achieved throughout the height of the fill or backfill:
1. Building and Pool Areas – One compaction test per 2,500 square feet of building footprint, for each lift.
2. Pavement Areas – One compaction test per each 10,000 square feet of pavement area, for each lift.
3. Utility Trenches – One compaction test per each 150 linear feet of trench, for each lift.

4. Landscaped Areas – One compaction test per each 20,000 square feet, for each lift.
5. All areas – One moisture content test per 5,000 square feet, for each lift.

3.17 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
   1. Provide a smooth transition between adjacent existing grades and new grades.
   2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
   1. Turf or Unpaved Areas: Plus or minus 1 inch (25 mm).
   2. Walks: Plus or minus 1 inch (25 mm).
   3. Pavements: Plus or minus 1/2 inch (13 mm).

C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch (13 mm) when tested with a 10-foot (3-m) straightedge.

3.18 SUBSURFACE DRAINAGE

A. Subdrainage Pipe: Specified in Division 2 Section "Subdrainage."

B. Subsurface Drain: Place subsurface drainage geotextile around perimeter of subdrainage trench. Place a 6-inch (150-mm) course of filter material on subsurface drainage geotextile to support subdrainage pipe. Encase subdrainage pipe in a minimum of 12 inches (300 mm) of filter material, placed in compacted layers 6 inches (150 mm) thick, and wrap in subsurface drainage geotextile, overlapping sides and ends at least 6 inches (150 mm).
   1. Compact each filter material layer to 85 percent of maximum dry unit weight according to ASTM D698.

C. Drainage Backfill: Place and compact filter material over subsurface drain, in width indicated, to within 12 inches (300 mm) of final subgrade, in compacted layers 6 inches (150 mm) thick. Overlay drainage backfill with one layer of subsurface drainage geotextile, overlapping sides and ends at least 6 inches (150 mm).

3.19 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

A. Place subbase course and base course on subgrades free of mud, frost, snow and ice.

B. On prepared subgrade, place subbase course and base course under pavements and walks as follows:
   1. Install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
   2. Place base course material over subbase course under hot-mix asphalt pavement.
   3. Shape subbase course and base course to required crown elevations and/or cross-slope grades.
   4. Place subbase course and base course 6 inches (150 mm) or less in compacted thickness in a single layer.
   5. Place subbase course and base course that exceeds 6 inches (150 mm) in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick.
   6. Compact subbase course and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D698.

3.20 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

A. Place drainage course on subgrades free of mud, frost, snow, and ice.

B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:
   1. Install subdrainage geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
   2. Place drainage course 6 inches (150 mm) or less in compacted thickness in a single layer.

3. Place drainage course that exceeds 6 inches (150 mm) in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick.
4. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D698.

3.21 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
   1. Determine prior to placement of fill that site has been prepared in compliance with requirements.
   2. Determine that fill material and maximum lift thickness comply with requirements.
   3. Determine, at the required frequency, that in-place density of compacted fill complies with requirements.

B. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.

C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

D. Testing agency will test compaction of soils in place according to ASTM D1556, ASTM D2167, ASTM D2922, and ASTM D2937, as applicable. Tests will be performed at the following locations and frequencies:
   1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft. (186 sq. m) or less of paved area or building slab, but in no case fewer than three tests.
   2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for every 100 feet (30 m) or less of wall length, but no fewer than two tests.
   3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 150 feet (46 m) or less of trench length, but no fewer than two tests.

E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.22 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
   1. Scarify or remove and replace soil material to depth as directed by Project Manager; reshape and re-compact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
   1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.23 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION

SECTION 31 2316

EXCAVATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools and services required to fully complete all Excavation work as required by the Drawings and/or specified herein including, but not limited to, the following described items
   1. Perform Project excavating and trenching as described in Contract Documents, except as specified below.
   2. Procedure and quality for excavating and trenching performed on Project under other Sections unless specifically specified otherwise.

1.02 RELATED REQUIREMENTS

A. Section 31 0501: Common Earthwork Requirements.

B. Section 31 1100: Clearing and Grubbing.

C. Performance of excavating inside and outside of building required for electrical and mechanical work is responsibility of respective Section doing work unless arranged differently by Contractor.

1.03 QUALITY ASSURANCE

A. Pre-Installation Conference: Participate in pre-installation conference specified in Section 31 2213.

PART 2 - PRODUCTS: NOT USED

PART 3 - EXECUTION

3.01 EXAMINATION

A. Carefully examine site and available information to determine type soil to be encountered. Discuss problems with Architect before proceeding with work.

3.02 PREPARATION

A. Protection of Existing Utilities:
   1. Protect existing utilities identified in Contract Documents during excavation.
   2. If existing utility lines not identified in Contract Documents are encountered, contact Architect before proceeding.

3.03 PERFORMANCE

A. Excavation:
   1. Building Footings And Foundations:
      a. Excavate as necessary for proper placement and forming of footings and foundations.
      b. Bottom of excavations to receive footings shall be undisturbed soil or fill placed per the site geotechnical study.
      c. Excavation Carried Deeper Than Required:

1) Under Footings not requiring over-excavation: Fill with concrete specified for footings.
2) Under Slabs: Use specified compacted backfill material.

2. Pavement And Miscellaneous Cast-In-Place Concrete:
   a. Excavate as necessary for proper placement and forming of concrete site elements and pavement structure. Remove vegetation and deleterious material and remove from site.
   b. Backfill over-excavated areas with compacted base material specified in Section 31 2324.
   c. Remove and replace exposed material that becomes soft or unstable.
3. Utility Trenches:
   a. Unless otherwise indicated, excavation shall be open cut. Short sections of trench may be tunneled if pipe or duct can be safely and properly installed and backfill can be properly tamped in tunnel sections and if approved by Architect.
   b. Excavate to proper alignment, depth, and grade. Excavate to sufficient width to allow adequate space for proper installation and inspection of utility piping.
   c. If trenches are excavated deeper than required, backfill until trench bottom is proper depth with properly compacted base material specified in Section 31 2324.
   d. Pipe 4-inch In Diameter or Larger:
      1) Grade bottom of trenches to provide uniform bearing and support for each section of pipe on undisturbed soil at every point along its length.
      2) Except where rock is encountered, take care not to excavate below depths indicated.
         (a) Where rock excavations are required, excavate rock with minimum over-depth of 4-inches below required trench depths.
         (b) Backfill over-depths in rock excavation and unauthorized over-depths with loose, granular, moist earth thoroughly compacted.
      3) Whenever wet or unstable soil incapable of properly supporting pipe, as determined by Architect, occurs in bottom of trench, remove soil to depth required and backfill trench to proper grade with coarse sand, fine gravel, or other suitable material acceptable to Architect.
4. If unusual excavating conditions are encountered, stop work and notify Architect.

3.04 REPAIR / RESTORATION

A. Repair damage to other portions of the Work resulting from work of this Section at no additional cost to Owner. On new work, arrange for damage to be repaired by original installer.

3.05 CLEANING

A. Debris and material not necessary for Project are property of Contractor and are to be removed before completion of Project. However, if material necessary for Project is hauled away, replace with specified fill / backfill material.

END OF SECTION 31 2316

SECTION 31 2319

DEWATERING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes
   1. Construction dewatering.

1.02 PERFORMANCE REQUIREMENTS

A. Dewatering Performance: Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of ground water and permit excavation and construction to proceed on dry, stable subgrades.
   1. Delegated Design: Design dewatering system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
   2. Continuously monitor and maintain dewatering operations to ensure erosion control, stability of excavations and constructed slopes, that excavation does not flood, and that damage to subgrades and permanent structures is prevented.
   3. Prevent surface water from entering excavations by grading, dikes, or other means.
   4. Accomplish dewatering without damaging existing buildings, structures, and site improvements adjacent to excavation.
   5. Remove dewatering system when no longer required for construction.

B. Dewatering activities are to comply with requirements of the Soil Conservation District (SCD).

1.03 SUBMITTALS

A. Shop Drawings: For dewatering system. Show arrangement, locations, and details of wells and well points; locations of risers, headers, filters, pumps, power units, and discharge lines; and means of discharge, control of sediment, and disposal of water.
   1. Include layouts of piezometers and flow-measuring devices for monitoring performance of dewatering system.
   2. Include a written plan for dewatering operations including control procedures to be adopted if dewatering problems arise.

B. Qualification Data: For qualified Installer.

C. Field quality-control reports.

D. Other Informational Submittals:
   1. Photographs: Show existing conditions of adjoining construction and site improvements that could be misconstrued as damage caused by dewatering operations.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer that has specialized in design of dewatering systems and dewatering work.

B. Regulatory Requirements: Comply with governing EPA and SCD notification regulations before beginning dewatering. Comply with hauling and disposal regulations of authorities having jurisdiction.

C. Pre-Installation Meeting: Conduct meeting at Project site.
   1. Review methods and procedures related to dewatering including, but not limited to, the following:
      a. Inspection and discussion of condition of site to be dewatered including coordination with temporary erosion control measures and temporary controls and protections.
      b. Geotechnical report.
      c. Proposed site clearing and excavations.
      d. Existing utilities and subsurface conditions.
      e. Coordination for interruption, shutoff, capping, and continuation of utility services.

f. Construction schedule. Verify availability of Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
g. Testing and monitoring of dewatering system.

1.05 PROJECT CONDITIONS

A. Interruption of Existing Utilities: Do not interrupt any utility serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:
   1. Notify Architect/Engineer no fewer than two days in advance of proposed interruption of utility.
   2. Do not proceed with interruption of utility without Architect's/Engineer's written permission.

B. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer. Owner will not be responsible for interpretations or conclusions drawn from this data.
   1. Make additional test borings and conduct other exploratory operations necessary for dewatering.
   2. The geotechnical report is included elsewhere in the Project Manual.

C. Survey Work: Engage a qualified professional land surveyor licensed to practice in California to survey adjacent existing buildings, structures, and site improvements, establishing exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.
   1. During dewatering, regularly resurvey benchmarks, maintaining an accurate log of surveyed elevations for comparison with original elevations. Promptly notify Architect if changes in elevations occur or if cracks, sags, or other damage is evident in adjacent construction.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by dewatering operations.
   1. Prevent surface water and subsurface or ground water from entering excavations, pavement subgrades and porous pavement area, from ponding on prepared subgrades, and from flooding site and surrounding area.
   2. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.

B. Install dewatering system to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
   1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

C. Provide temporary grading to facilitate dewatering and control of surface water.

D. Monitor dewatering systems continuously.

E. Promptly repair damages to adjacent facilities caused by dewatering.

F. Protect and maintain temporary erosion and sedimentation controls, which are specified in Division 1 Section "Temporary Facilities and Controls" Division 2 Section "Site Clearing" during dewatering operations.

3.02 INSTALLATION

A. Install dewatering system utilizing wells, well points, or similar methods complete with pump equipment, standby power and pumps, filter material gradation, valves, appurtenances, water disposal, and surface-water controls.
   1. Space well points or wells at intervals required to provide sufficient dewatering.
   2. Use filters or other means to prevent pumping of fine sands or silts from the subsurface.

B. Before excavating below ground-water level, place system into operation to lower water to specified levels. Operate system continuously until drains, sewers, and structures have been constructed and fill materials have been placed or until dewatering is no longer required.

C. Provide an adequate system to lower and control ground water to permit excavation, construction of structures, and placement of fill materials on dry subgrades. Install sufficient dewatering equipment to drain water-bearing strata above and below bottom of foundations, drains, sewers, and other excavations.
   1. Do not permit open-sump pumping that leads to loss of fines, soil piping, subgrade softening, and slope instability.

D. Reduce hydrostatic head in water-bearing strata below subgrade elevations of foundations, drains, sewers, and other excavations.
   1. Maintain piezometric water level a minimum of 24 inches (600 mm) below surface of excavation.

E. Dispose of water removed by dewatering in a manner that complies with requirements of the SCD and avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction.

F. Provide standby equipment on site, installed and available for immediate operation, to maintain dewatering on continuous basis if any part of system becomes inadequate or fails. If dewatering requirements are not satisfied due to inadequacy or failure of dewatering system, restore damaged structures and foundation soils at no additional expense to Owner.
   1. Remove dewatering system from Project site on completion of dewatering. Plug or fill well holes with sand or cut off and cap wells a minimum of 36 inches (900 mm) below overlying construction.

G. Damages: Promptly repair damages to adjacent facilities caused by dewatering operations.

3.03 FIELD QUALITY CONTROL

A. Observation Wells: Provide, take measurements, and maintain at least the minimum number of observation wells or piezometers indicated; additional observation wells may be required by authorities having jurisdiction.
   1. Observe and record daily elevation of ground water and piezometric water levels in observation wells.
   2. Repair or replace, within 24 hours, observation wells that become inactive, damaged, or destroyed. In areas where observation wells are not functioning properly, suspend construction activities until reliable observations can be made. Add or remove water from observation-well risers to demonstrate that observation wells are functioning properly.
   3. Fill observation wells, remove piezometers, and fill holes when dewatering is completed.

B. Provide continual observation to ensure that subsurface soils are not being removed by the dewatering operation.

END OF SECTION 31 2319

SECTION 31 2323

FILL

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools and services required to fully complete all Fill work as required by the Drawings and/or specified herein including, but not limited to, the following described items
   1. Perform Project backfilling and compacting as described in Contract Documents, except as specified below.
   2. Procedure and quality for backfilling and compacting performed on Project under other Sections unless specifically specified otherwise.

1.02 RELATED REQUIREMENTS

A. Section 31 0501: Common Earthwork Requirements.

B. Division 32: Compaction of sub-grade under walks and paving.

C. Performance of backfilling and compacting inside and outside of building required for electrical and mechanical work is responsibility of respective Section doing work unless arranged differently by Contractor.

1.03 DEFINITIONS

A. Relative Compaction: Ratio of field dry density as determined by ASTM D 2922 and ASTM D 3017 or 2216, and laboratory maximum dry density as determined by ASTM D 1557.

1.04 QUALITY ASSURANCE

A. Pre-Installation Conference: Participate in pre-installation conference specified in Section 31 2213.

1.05 SEQUENCING

A. Do not backfill against bituminous dampproofing for 24 hours after application of dampproofing.

B. Before backfilling, show utility and service lines being covered on record set of Drawings. Do not backfill until utilities involved have been tested and approved by Architect until instructed by Architect.

PART 2 - PRODUCTS

2.01 ALL TO BE APPROVED BY ARCHITECT

2.02 MATERIALS

A. Imported Fill / Backfill:
   1. Well graded material conforming to ASTM D 2487 free from debris, organic material, frozen materials, brick, lime, concrete, and other material which would prevent adequate performance of backfill.
      a. Under Site Concrete and Paved Areas: Fill shall consist of non expansive granular soil with no more that 50% passing the number 200 Sieve and a liquid limit of less

than 30%. Fill may not contain stones over 6-inches and 90 percent minimum of fill shall be smaller than 1.5-inches in any direction.

b. Under Landscaped Areas:
   1) Fill more than 36-inches below finish grade shall comply with soil classification groups GW, GP, GM, SW, SP, or SM. Fill may not contain stones over 6-inches diameter and 90 percent minimum of fill shall be smaller than 1.5-inches in any direction.
   2) Fill less than 36-inches below finish grade shall comply with soil classification groups SW, SP, SM, or SC. Fill may not contain stones larger than 1.5-inches in any direction and 90 percent minimum of fill shall be smaller than 0.25-inches in any direction.

B. Engineered Fill:
   1. To be approved by Architect

PART 3 - EXECUTION

3.01 PREPARATION

A. Before placing fill, base, or finish work, prepare sub-grade as follows:
   1. Do not place fill or base over frozen sub-grade.
   2. Under Building Slabs / Pads, Concrete Site Elements, And Concrete Driveways And Parking Areas: Scarify sub-grade 6-inches deep, moisture condition to uniform moisture content and plus or minus 2% of optimum, and mechanically 6-inches deep to 95 percent minimum compaction.
   3. Under Asphalt Driveways And Parking Areas: Scarify sub-grade 6-inches deep, moisture condition to uniform moisture content between optimum and plus or minus 2% of optimum, and mechanically tamp to 95 percent minimum compaction.
   4. Landscape Areas: Compact sub-grade to 90 percent compaction.

3.02 PERFORMANCE

A. Fill / Backfill:
   1. General:
      a. Around Buildings And Structures: Slope grade away from building as specified in Section 31 2216. Hand backfill when close to building or where damage to building might result.
      b. Site Utilities:
         1) In Landscape Areas: Use approved existing topsoil stored on site as a result of work of Section 31 1413 or materials approved based on Part 2 of this Section.
         2) Under Pavement and Concrete Site Elements: Materials approved based on Part 2 of this Section.
      c. Do not use puddling or jetting to consolidate fill areas.
   2. Compacting:
      a. Fill / Backfill And Base:
         1) Under Building Slabs or Pads, Driveways, Parking Areas Under Concrete Site Elements And Around Foundation Walls: Place in 8-inches maximum layers, moisture condition to plus or minus 2 percent of optimum moisture content, and mechanically tamp to 95 percent minimum of maximum density as established by ASTM D 1557.
         2) Utility Trenches:
            (a) Site: Place fill in 8-inch layers and moisture condition to plus or minus 2 percent of optimum moisture content. Compact fill to 95 percent minimum relative compaction.

(b) Under Concrete or Asphalt: Place fill in 6-inch layers, moisture condition to plus or minus 2 percent of optimum moisture content, and compact to 95 percent minimum relative compaction to established sub-grade elevation.

3) Fill Slopes: Compact by rolling or using sheepsfoot roller to minimum density as established by Architect.
4) Backfill Under Footings: Not allowed, unless specified on drawings.
5) Other Backfills outside traffic areas: Place other fills in 12-inch layers and compact to 90 percent relative compaction.

3.03 REPAIR / RESTORATION

A. Repair damage to other portions of the Work resulting from work of this Section at no additional cost to Owner. On new work, arrange for damage to be repaired by original installer.

3.04 CLEANING

A. Debris and material not necessary for Project are property of Contractor and are to be removed before completion of Project. However, if material necessary for Project is hauled away, replace with specified fill / backfill material.

END OF SECTION 31 2323

SECTION 31 1216

ASPHALT PAVING – SUPERPAVE METHOD

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools and services required to fully complete all Asphalt Paving work as required by the Drawings and/or specified herein including, but not limited to, the following described items:
   1. Furnish and install asphalt paving in driveways and parking areas as described in Contract Documents.

1.02 RELATED REQUIREMENTS:

A. Section 01 1200: 'Multiple Contract Summary' for multiple contracts.

B. Section 01 4523: 'Testing and Inspecting Services' for testing and inspection, and testing laboratory services for materials, products, and construction methods.

C. Section 31 0501: 'Common Earthwork Requirements' for:
   1. General procedures and requirements for earthwork.
   2. Pre-installation conference held jointly with other common earthwork related sections.

D. Section 31 2213: 'Rough Grading' for rough grading and preparation of natural soil subgrades below fill and aggregate base materials.

E. Section 31 2216: 'Fine Grading' for grading of subgrade below aggregate base and topsoil.

F. Section 31 2323: 'Fill' for compaction procedures and tolerances for base.

G. Section 32 1123: 'Aggregate Base' for compaction of aggregate base.

H. Section 32 0113.01: 'Asphalt Paving Surface Treatment: Penetrating Seal'.

I. Section 32 1717: 'Asphalt Reinforcement Fibers'.

J. Section 32 1723: 'Pavement Markings'.

1.03 PRICE AND PAYMENT PROCEDURES

A. Alternates:
   1. Asphalt Reinforcement Fibers are bid as Alternate 'A' as specified in Price and Payment Procedures in Part 1 of Section 32 1216. Owner's Representative will review bid and decide if asphalt reinforcing fibers will be included in Project.

1.04 REFERENCES

A. Association Publications:
   1. Asphalt Institute, 2696 Research Park Dr., Lexington, KY www.asphaltinstitute.org:
      a. MS-2, 'Mix Design Methods' (7th Edition 2015).

B. Definitions:
   1. Aggregate: Hard inert mineral material, such as gravel, crushed rock, slag, or sand.
      a. Coarse Aggregate: Aggregate retained on or above No. 4 (4.75 mm) sieve.
      b. Coarse-Graded Aggregate: Aggregate having predominance of coarse sizes.

c. Dense-Graded Aggregate: Aggregate that is graded from maximum size down through filler with object of obtaining an asphalt mix with controlled void content and high stability.
d. Fine Aggregate: Aggregate passing No. 4 (4.75 mm) sieve.
e. Fine-Graded Aggregate: Aggregate having predominance of fine sizes.
f. Mineral Filler: Fine mineral product at least 70 percent of which passes a No. 200 (75µm) sieve.

2. Air Voids: Total volume of small air pockets between coated aggregate particles in asphalt cement concrete (ACC); expressed as percentage of bulk volume of compacted paving mixture.
3. Anti-Stripping Agent: Chemicals added to bitumen to improve the adhesion of the bitumen to hydrophilic aggregates
4. Asphalt Binder: Asphalt cement or modified asphalt cement that binds aggregate particles into dense mass.
   a. Asphalt Cement used in paving applications that has been classified according to the Standard Specification for Performance Graded Asphalt Binder, AASHTO Designation MP 320. It can be either unmodified or modified Asphalt Cement, as long as it complies with specifications.
5. Asphalt-Aggregate Designator: Alpha-numeric code that indicates nominal maximum size of aggregate, and type and grade of asphalt in aggregate-asphalt mix.
   a. Example: "12.5 PG70-28" means aggregate asphalt mix shall be composed of aggregate gradation with 12.5 mm (1/2 inch) nominal maximum size and performance grade asphalt binder designed to perform between temperatures of 70 deg C and -28 deg C (158 deg F and -18.4 deg F).
6. Equivalent Single Axle Load (ESAL): Effect on pavement performance of any combination of axle loads of varying magnitude equated to number of 18,000-lb. (80-kN) single-axle loads that are required to produce an equivalent effect.
7. Maximum Size (Superpave): One sieve larger than the nominal maximum size.
8. N design (Superpave): Design number of gyrations used for design of Hot Mix Asphalt (HMA).
9. Nominal Maximum Size: One sieve size larger than first sieve size retaining more than 10 percent of Sample. Nominal maximum size sieve will retain minimum of 0 and maximum of 10 percent of sample. Maximum size is one sieve size larger than nominal maximum size.
10. Performance Graded Asphalt Binder (PGAB): Asphalt binder designed to produce HMA that meets certain performance standards. Designations for performance-graded asphalt binders are prefixed with PG. Each grade designation also includes two sets of numbers that denote temperature range. This is a range of climate temperatures to which road may be exposed and still be expected to give superior performance. PG numbers do not indicate viscosity as in conventional liquid asphalt designations.
11. Pre-emergent Herbicide: Chemical that is applied before weeds emerge. It acts by killing weed seedlings and /or establishing layer of chemical on or near soil surface that is toxic to germinating seeds and young seedlings.
12. Reclaimed Asphalt Pavement (RAP): Existing asphalt mixture that has been pulverized, usually by milling, and is used like aggregate in recycling of asphalt pavements.
13. Subgrade (definition varies depending upon stage of construction and context of work being performed):
    a. Prepared natural soils on which fill, aggregate base, or topsoil is placed.
    b. or
    c. Prepared soils immediately beneath paving.
14. Tack Coat: Very light application of liquid asphalt, or asphalt emulsion diluted with water.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conferences:

1. Participate in MANDATORY pre-installation conference as specified in Section 31 0501 'Common Earthwork Requirements':
2. In addition to agenda items specified in Section 01 3100 'Project Management and Coordination' and Section 31 0501 'Common Earthwork Requirements', review following:
    a. Review surveying and staking of parking areas and installation of sleeves.
    b. Review proposed aggregate base schedule.
    c. Review rough grading elevations before placing paving fill.
    d. Review fine grading elevations of subgrade fine grading operations before placing aggregate base and paving.
    e. Review proposed asphalt paving schedule.
    f. Review asphalt paving mix design.
    g. Review pre-emergent herbicide protection of adjoining property and planting area on site requirements, schedule and application requirements.
    h. Review schedule of mandatory asphalt paving surface treatment to be applied after placement of asphalt paving.
    i. Review schedule of paint stripes to be applied after asphalt paving surface treatment.
    j. Review safety issues.
    k. Review Section 01 4523 'Testing and Inspecting Services' for administrative requirements and responsibilities and Field Quality Control tests and inspections required of this section.
        1) Review requirements and frequency of testing and inspections.
        2) Review Contractor Testing Agency Qualifications.

B. Scheduling:
    1. Notify Testing Agency and Architect twenty-four (24) hours minimum before placing asphalt paving.

1.06 SUBMITTALS

A. Action Submittals:
    1. Product Data:
        a. Pre-Emergent Herbicide:
            1) Manufacturer's published product data on pre-emergent herbicide.

B. Informational Submittals:
    1. Certificates:
        a. Require mix plant to furnish delivery/load tickets for each batch of asphalt. Keep delivery tickets at job-site for use of Owner's Representative. Tickets shall show following:
            1) Name of mix plant.
            2) Date.
            3) Name of contractor.
            4) Name and location of Project.
            5) Serial number of ticket.
            6) Asphalt mix type.
            7) Time loaded.
            8) Identity of truck.
            9) Installer to provide Manufacturer's Certificate of Compliance stating material authenticity and properties for review and acceptance by Architect before product use.
    2. Design Data:
        a. Hot Mix Asphalt:
            1) Design Criteria:
                (a) Develop mix design according to current Asphalt Institute MS-2 'Asphalt Mix Design Methods' for Superpave Methodand Section 02641.2.2 Asphalt

Paving Mixes and Mix Design of the Saratoga Springs City Standards and Specifications, 2019 Edition.

(b) Submittal format:

(1) Design mix submittal shall follow format as indicated in current Asphalt Institute MS-2, 'Mix Design Methods.

2) Mix design of asphalt paving must meet Design Criteria minimum requirements and show conformance to the following:

(a) Location and name of hot mix asphalt concrete production facility.
(b) Date of mix design. If older than two (2) years, recertify mix design.
(c) Asphalt mix type.
(d) Mix design method used.
(e) Mix density.
(f) Design air voids (three and one half (3.5) percent.
(g) Asphalt content in percent.
(h) Performance grade of asphalt binder.
(i) Nominal maximum size of aggregate.
(j) Maximum size of aggregate.
(k) Aggregate source and gradation.
(l) Mix properties and design parameters.
(m) Temperature of mix at plant and in the field for optimum field compaction.
(n) Amount of recycled asphalt pavement (RAP).
(o) Mineral fillers, antistrip, and recycle agent percentages.
(p) Identify if warm mix technologies will be used and how much warm mix additive will be used.

3) Within thirty (30) days prior to asphalt construction, submit actual design mix to Architect, Civil Engineering Consultant of Record and Independent Testing Laboratory for review and approval.

3. Test And Evaluation Reports:
   a. Hot Mix Asphalt:
      1) Contractor's Testing Agency copies of Field Test results to show compliance with all contract requirements and quality control for quality of asphalt mixture and asphalt installation.
      2) Owner's Testing Agency copies of Field Tests and Inspections used to validate or determine discrepancies with testing by Contractor.
4. Manufacturer Instructions:
   a. Pre-Emergent Herbicide:
      1) Application instructions for pre-emergent herbicide.
5. Qualification Statement:
   a. Installer:
      1) Provide Qualification documentation if requested by Owner's Representative.

C. Closeout Submittals:
   1. Include following in Operations And Maintenance Manual specified in Section 01 7800 'Closeout Submittals':
      a. Record Documentation:
         1) Manufacturer's documentation:
            (a) Pre-emergent herbicide documentation.
            (b) Asphalt paving design.
            (c) Test reports.
            (d) Certificates from mix plant of delivery/load tickets.
            (e) Manufacturer's Certificate of Compliance.
         2) Testing and Inspection Reports:
            (a) Testing Agency Testing and Inspecting Reports of asphalt paving.

1.07 QUALITY ASSURANCE

A. Qualifications. Requirements of Section 01 4300 'Quality Assurance - Qualifications' applies but not limited to following:
   1. Asphalt Paving:
      a. Foreman of asphalt paving crew has completed at least three (3) projects of similar size and nature.
      b. Upon request, submit documentation.
   2. Pre-emergent herbicide:
      a. Applicator:
         1) Pre-emergent herbicide shall be applied by applicator certified by State in which Project is located as an applicator of agricultural chemicals.

B. Testing and Inspection:
   1. Owner is responsible for Quality Assurance. Quality assurance performed by Owner will be used to validate Quality Control performed by Contractor.
   2. Owner will provide Testing and Inspection for asphalt paving:
      a. Owner will employ testing agencies to perform testing and inspection for asphalt paving as specified in Field Quality Control in Part 3 of this specification.
         1) Owner's employment of an independent Testing Agency does not relieve Contractor of Contractor's obligation to perform the Work in strict accordance with requirements of Contract Documents and perform contractor testing and inspection.
         2) See Section 01 1200: 'Multiple Contract Summary'.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Delivery And Acceptance Requirements:
   1. Asphalt Material:
      a. Each shipment must:
         1) Be uniform in appearance and consistency.
         2) Show no foaming when heated to specified loading temperature.
         3) Do not supply shipments contaminated with other asphalt types or grades than those specified:
            (a) Do not use petroleum distillate as a release agent.
   2. Pre-emergent herbicide:
      a. Materials shall be delivered in original, unopened packages with labels intact.

B. Storage And Handling Requirements:
   1. Pre-emergent herbicide:
      a. Do not freeze. Store in at temperatures above 41 deg F (5 deg C).
      b. Follow Manufacturer's storage and handling requirements.

1.09 FIELD CONDITIONS

A. Ambient Conditions:
   1. Pre-emergent herbicide:
      a. Follow printed Manufacturers instruction for environmental hazards:
      b. Follow printed Manufacturers instruction ambient conditions for application of product.
   2. Tack Coat:
      a. Apply only when air and roadbed temperatures in shade are greater than 40 deg F (4.4 deg C). Temperature restrictions may be waived only upon written authorization from Architect or Civil Engineer.
      b. Do not apply to wet surfaces.
      c. Do not apply when weather conditions prevent tack coat from adhering properly.

3. Asphalt paving:
    a. Do not perform work during following conditions:
        1) Ambient temperature is below 50 deg F (7.2 deg C) or will fall below 50 deg F (7.2 deg C) during placement.
        2) Temperature of aggregate base below 50 deg F (10 deg C).
        3) Cold Weather Asphalt Paving Plan: If asphalt pavement is placed outside of these temperature limits or those identified in MINIMUM Temperature Degrees, a plan is required which includes:
            (a) Haul times.
            (b) Placement details.
            (c) Compaction aids used in production.
            (d) Owner does not assume responsibility for asphalt when placed outside temperature limits.
        4) Presence of free surface water or weather is unsuitable.
        5) Wind or ground cools mix material before compaction.

PART 2 - PRODUCTS

2.01 DESIGN CRITERIA

A. General:
    1. Follow current Asphalt Institute MS-2 'Asphalt Mix Design Methods' for Superpave Method.
    2. Follow Section 02641.2.2 Asphalt Paving Mixes and Mix Design of the Saratoga Springs City Standards and Specifications, 2019 Edition.

B. Asphalt Mix:
    1. Asphalt Binder:
        a. Performance Graded Asphalt Binder:
            1) Use PG 64-28 conforming to APWA Standard Specifications Section 32 1205 or UDOT Standards Specifications Section 02745.
    2. Aggregates:
        a. Use clean, hard, durable, angular, sound, consisting of crushed stone, crushed gravel, slag, sand, or combination.
        b. Use nominal maximum size aggregate and maximum size aggregate Section 02641.2.1 Materials of the Saratoga Springs City Standards and Specifications, 2019 Edition.

2.02 MATERIAL

A. Aggregate Base: Conform to applicable requirements as specified in Section 31 1123: 'Aggregate Base'.

B. Asphalt Paving Surface Treatment:
    1. Include mandatory Asphalt Paving Surface Treatment to be applied no sooner than thirty (30) days or no later than eighteen (18) months of placing Asphalt Paving to be included with this project:
        a. Asphalt Based Penetrating Seal as specified in Section 32 0113.01 'Asphalt Paving Surface Treatment: Asphalt Based Penetrating Seal'.

C. Pre-Emergent Herbicide:
    1. Design Criteria:
        a. Selective type pre-emergence control chemical containing twenty-five (25 percent) Prometon minimum for control of annual grasses and broadleaf weeds.
        b. Non-oil based sterilant.

c. Labeled for under-pavement use.
2. Type Two Acceptable Products:
a. Pramitol 25E Herbicide by WinField United, St Paul MN www.winfieldunited.com.
1) Apply at a rate of 10 gal (37.85 liter) per 1 acre (0.4046863 hectare) conforming to application rates indicated on product label.
2) Equal as approved by Architect before installation. See Section 01 6200.

D. Reclaimed Asphalt Pavement (RAP). Aggregate: Restrictions include:
1. Allowed up to 15 percent.

E. Tack Coat:
1. Emulsified asphalt meeting requirements of ASTM D977, Grade SS-1H, CQS-1H, or ASTM D2397/D2397M, Grade CSS-1H.

PART 3 - EXECUTION

3.01 INSTALLERS

A. Approved Applicators. See Section 01 4300 'Quality Assurance - Qualifications':

3.02 PREPARATION

A. General:
1. Aggregate base and paving must be placed before any moisture or seasonal changes occur to subgrade that would cause compaction tests previously performed to be erroneous. Re-compact and retest subgrade soils that have been left exposed to weather.

B. Protection Of In-Place Conditions:
1. Pre-emergent herbicide:
a. Take necessary precautions to protect adjoining property and areas designated for planting on building site.
b. Do not contaminate any body of water by direct application, cleaning of equipment or disposal of wastes.
2. Asphalt Paving:
a. Protect all structures, including curb, gutter, sidewalks, guard rails and guide posts.
b. Protect neighborhood, storm drains and down-stream fish habitat.

C. Surface Preparation:
1. Survey and stake parking surfaces to show grading required by Contract Documents.
2. Subgrade (soil below aggregate base):
a. Prepare natural soil subgrade as specified in Section 31 2213 'Rough Grading' or prepare fill subgrade as described in Section 31 2216 'Fine Grading'.
3. Aggregate base:
a. Finish grade parking surface area to grades required by Contract Documents.
b. Compact aggregate base as specified in Section 31 1123 'Aggregate Base'.
c. Tolerances:
1) Elevation of aggregate base shall be 0.00 inches (0.00 mm) high and no more than 1/2 inch (12.7 mm) low.
2) Measure using string line from curb to curb, gutter, flat drainage structure, or grade break.
4. Tack coat:
a. Clean surface of all materials such as mud, dirt, leaves, etc. that prevent tack from bonding to existing surfaces.
1) If flushed, allow surface to dry.
5. Asphalt paving:

a. Area shall be clean and tack coat applied before placing of asphalt paving.
    1) Remove all moisture, dirt, sand, leaves, and other objectionable material from prepared surface before placing asphalt.
    2) Locate, reference, and protect all utility covers, monuments, curb, and gutter and other components affected by asphalt paving operations.
    3) Allow sufficient cure time for tack coat before placing asphalt.

3.03 APPLICATION

A. Interface With Other Work:
1. Section 32 1123: 'Aggregate Base' for compaction of aggregate base.
2. Section 31 2213: 'Rough Grading' for rough grading and preparation of natural soil subgrades below fill and aggregate base materials.
3. Section 31 2216: 'Fine Grading' for grading of subgrade below aggregate base and topsoil.
4. Section 31 2323: 'Fill' for compaction procedures and tolerances.

B. Pre-Emergent Herbicide:
1. Asphalt paving areas:
    a. Follow Manufacturer's printed application requirements:
    b. Apply to prepared subgrade dispersed in liquid. Concentrate shall be such that Manufacturer's full recommended amount of chemical will be applied to every 1000 sq ft (93 sq m) and liquid will penetrate minimum of 2 inches (50 mm).
    c. Application shall be no more than one (1) day before installation of aggregate base.

C. Tack Coat:
1. General:
    a. Tack coat vertical surfaces or existing asphalt cement concrete or portland cement concrete that will be in contact with asphalt paving.
    b. Use tack coat diluted to a 2:1 (concentrate water) ratio.
    c. Use pressure distributor to apply in uniform, continuous spread.
    d. Cover all tacked surface areas with surfacing materials same day of application.
2. Application rate. Typically, as follows:
    a. Emulsions, 0.08 to 0.15 gallons per sq yd (0.303 to 0.679 L per sq m) of diluted material:
        1) Apply sufficient to achieve ninety-five (95) percent or better coverage of existing surfaces.
        2) Above application rates may vary according to field conditions. Obtain approval from Civil Engineer for quantities, rate of application, temperatures, and areas to be treated before any application.

D. Asphalt Paving:
1. General:
    a. Paving adjacent to cast-in-place concrete site elements shall be between 1/4 inch (6 mm) higher than concrete.
    b. Surface texture of hand worked areas shall match texture of machine-laid areas.
    c. Surface shall be uniform with no 'birdbaths'. Leave finished surfaces clean and smooth. Variations from specified grades shall not exceed 1/2 inch (12.7 mm).
    d. Cross Slope: 1/4 inch (6 mm) in 10 feet (3.0 m) perpendicular to centerline except at cross section grade breaks.
    e. Grade: 1/8 inch (3 mm) in 10 feet (3.0 m) parallel to centerline.
    f. Do not place on frozen aggregate base or during adverse climatic conditions such as precipitation or when roadway surface is icy or wet.
    g. Uniformly mix materials so aggregate is thoroughly coated with asphalt.

h. Place at temperatures established by the mix design with self-propelled laydown machine.
i. Use Table 3 - MINIMUM TEMPERATURE, DEGREES as guide:

Table 3 – MINIMUM TEMPERATURE, DEGREES

Ambient Air Temperature Deg F.	Ambient Air Temperature Deg C.	Compacted Paving Mat Thickness					
		3/4" (19mm)	1" (25mm)	1.5" (38mm)	2" (50mm)	3" (75mm)	4" + (100mm)
50-59	10-15	-	-	-	280	270	255
60-69	16-20	-	-	285	275	265	250
70-79	21-79	285	285	280	270	265	250
80-89	27-31	280	275	270	265	260	250
90 +	32 +	275	270	265	260	250	250

j. Longitudinal bituminous joints shall be vertical and properly tack coated if cold. Transverse joints shall always be tack coated.

2. Compaction:
   a. Compact asphalt paving to ninety-four (94) percent plus or minus two (2) percent of theoretical maximum specific gravity, ASTM D2041/D2041M (Rice Method - maximum theoretical density).
   b. Roll with powered equipment capable of obtaining specified density while providing required smoothness.
   c. Begin breakdown rolling immediately after asphalt is placed when asphalt temperature is at maximum.
   d. Complete handwork compaction concurrently with breakdown rolling.
   e. Execute compaction so visibility of joints is minimized:
   f. Complete finish rolling to improve asphalt surface as soon as possible after intermediate rolling and while asphalt paving is still warm.
   g. Do not use vibration for finish rolling.
3. Lift Thickness:
   a. Preferred Method:
      1) For pavements 3-1/2 inch (89 mm) or thinner apply asphalt paving in single lift.
      2) For pavements greater than 3-1/2 inch (89 mm), use alternate method below.
   b. Alternate Method:
      1) Asphalt paving may be applied in two (2) lifts, first 2 inches (50 mm) thick minimum and second 1 1/2 inches (38 mm) thick minimum following temperature recommendations of following paragraph.
      2) Surface of first lift shall be clean and provide tack coat between first and second lifts.
      3) Provide not less than two (2) times maximum aggregate size in compacted asphalt concrete mixes.

E. Asphalt Paving Surface Treatments:
1. Apply mandatory Asphalt Paving Surface Treatment no sooner than thirty (30) days or no later than eighteen (18) months of placing Asphalt Paving to be included with this project. Do not apply prior to asphalt curing (refer to 'Asphalt, Concrete and Pervious Concrete Maintenance Guidelines'):
   a. Asphalt Based Penetrating Seal as specified in Section 32 0113.01 'Asphalt Paving Surface Treatment: Asphalt Based Penetrating Seal'.

F. Paint Stripes:
1. Apply paint stripes after asphalt paving surface treatment has been applied to asphalt paving.

3.04 FIELD QUALITY CONTROL

A. Field Tests And Inspections:
   1. Civil and structural field tests, laboratory testing, and inspections are provided by Owner's independent Testing Agency as specified in Section 01 4523 'Testing And Inspection Services':
      a. Quality Control is sole responsibility of Contractor:
         1) Owner's employment of an independent Testing Agency does not relieve Contractor of Contractor's obligation to perform testing and inspection as part of his Quality Control:
            (a) Testing and inspections will be responsibility of Contractor to be performed by an independent entity.
         2) Contractor bears full responsible for compliance with all contract requirements and quality control on project and will be responsible for quality of asphalt mixture and asphalt installation.

B. Field Tests (Provided by Contractor):
   1. General:
      a. Contractor bears full responsibility for compliance with all contract requirements and quality control on project and will be responsible for quality of asphalt mixture and asphalt installation.
      b. Testing and Inspection Reports to be distributed as specified in Section 01 4523 'Testing And Inspection Services'.
   2. Compaction Tests:
      a. Contractor to provide compaction tests of asphalt being placed to establish rolling patterns and installation procedures.
      b. Compaction tests by Contractor are independent of compaction tests being provided by Owner. See Section 01 4523 'Testing And Inspection Services'.
      c. Asphalt paving shall be compacted to ninety-four (94) percent of Theoretical Maximum Specific Gravity (Rice) plus three (3) percent or minus two (2) percent. Determine percent compaction by ASTM D2041/D2041M.
   3. Thickness Tests:
      a. Determine thickness of paving being placed, no less than one (1) test per 10,000 sq. ft. (930 sq. m) of paving or portion thereof, three (3) tests minimum.

C. Field Tests And Inspections (Provided by Owner):
   1. General:
      a. Compaction tests provided by Owner will be used to validate or determine discrepancies with testing by Contractor.
      b. Civil engineer applies pay factor for Gradation/Asphalt Content, In-Place Density. Civil engineer computes pay factor for each lot.
      c. Opening paved surface to traffic does not constitute acceptance.
      d. Unless required by the Owner's Representative, Testing Agency is to base compaction testing on Contractor's submitted mix design for theoretical maximum specific gravity (Rice) or Marshall specific gravity (Bulk) values.
      e. Asphalt-aggregate mix sampling as per ASTM D979/D979M.
         1) Test for:
            (a) Air voids as per ASTM D3203/D3203M.
            (b) Asphalt binder content as per ASTM D6307.
            (c) Aggregate gradation as per ASTM D5444.
      f. Lot size: 10,000 sq. ft. (930 sq. m) or part thereof.
      g. Sub lot size: 5,000 sq. ft. (465 sq. m) or part thereof.
   2. At Site Testing and Inspection:
      a. Asphalt Paving:

1) Testing Agency shall provide full time nuclear density testing and inspection for asphalt paving during asphalt paving operations (nuclear density testing is informational testing only and does not constitute acceptance by Owner).
2) Inspection to include:
   (a) Aggregate coating.
   (b) Compaction control and effort required.
   (c) Suitability of spreading and asphalt paving equipment.
   (d) Temperature of mix as delivered and placed.
      (1) Reject mixes exceeding 325 deg F (163 deg C) in transport vehicle as required in Non-Conforming Work below.
      (2) Dispose of cold mix in paver hopper as thin spread underlay.
3) Field Tests:
   (a) When tested with 10 foot (3 meter) straight edge, surface of completed work shall not contain irregularities in excess of 1/4 inch (6 mm).
   (b) Determine percent compaction per ASTM D2950/D2950M unless other nondestructive nonnuclear methods such as sonar are used.
   (c) Provide written nuclear density testing, or other nondestructive nonnuclear methods such as sonar, of asphalt paving at minimum rate of one (1) per 2,500 sq. ft. (232 sq. m). Select test locations by ASTM D3665 and sample per ASTM D979/D979M before compaction. Minimum of three (3) tests required.
   (d) Compact asphalt paving to ninety-four (94) percent of Theoretical Maximum Specific Gravity (Rice) plus three (3) percent or minus two (2) percent.
   (e) Maximum average total air voids in completed hot mix asphalt shall be eight (8) percent but more than three (3) percent as determined by ASTM D2041/D2041M.
   (f) Determine thickness of paving being placed, no less than one (1) test per 10,000 sq. ft. (930 sq. m) of paving or portion thereof, three (3) tests minimum.

3. At Laboratory Testing:
   a. General:
      1) Provide at least one (1) laboratory test series for every 10,000 sq. ft. (930 sq. m) or part thereof (minimum of one (1) test):
         (a) Test reports will show compliance with Contract Documents regarding type and depth of aggregate base, depth and density of asphalt paving, asphalt content, aggregate gradation, flow and stability, bulk specific gravity and maximum specific gravity.
         (b) Reports will also give test procedures used by testing laboratory.
   b. Compaction and Final Density:
      1) Pavement thickness and final density to be determined by results of coring. Provide one (1) core per 10,000 sq. ft. (930 sq. m) or part thereof. Minimum of three (3) tests required if under 30,000 sq. ft. (2 787 sq. m).
         (a) Based upon core samples, compaction is acceptable if test deviations are within pay factor 1.00 limits.
         (b) At Project Manager's discretion, after consulting with Design Team, a Lot with a sub-lot test deviation greater than Reject may stay in place at fifty (50) percent cost.
         (c) Select test locations by ASTM D3665 and sample per ASTM D979/D979M after compaction.
   c. Compaction Pay Factor:
      1) Based upon core samples, compaction is acceptable if test deviations are within pay factor 1.00 limits.
      2) At Project Manager's discretion, after consulting with design team, a Lot with a sub-lot test deviation greater than Reject may stay in place at fifty (50) percent cost.

3) Average Density, in percent as shown in Table 4 - COMPACTION PAY FACTORS:

Table 4 – COMPACTION PAY FACTORS (94 percent of theoretical maximum specific gravity – Superpave (Rice) (ASTM D2041/D2041M plus three (3) or minus two (2) percent)

Pay Factor	Density, in Percent	
	Average	Lowest Test
0.70	More than 96	---
1.00	92 to 96	89 or Greater
0.90	92 to 96	Less than 89
Reject	Less than 92	---

Notes: 1. At Contractor's discretion and expense, do Hamburg wheel track test (AASHTO T 304) on 3 additional random core samples from non-complying sub-lot of 5,000 sq. ft . (465 sq. m) . Sub-lot will be accepted if average rut depth is less than 10 mm at 20,000 passes.

d. Pavement Thickness:
   1) Pavement thickness and final density to be determined by results of coring. Provide one (1) core per 10,000 sq. ft. (930 sq. m) or part thereof. Minimum of three (3) tests required if under 30,000 sq. ft. (2 787 sq. m).
      (a) Acceptance will be based on the average of all thickness tests.
      (b) At Project Manager's discretion, after consulting with design team, payment may be made for areas deficient in thickness by more than 0.75 inches (19.05 mm) at fifty (50) percent. If not, remove and replace at no additional cost to the Owner as shown in Table 5 - THICKNESS PAY FACTORS:

Table 5 – THICKNESS PAY FACTORS

Pay Factors	Thickness Deficiency, in Inches (ASTM D3549/D3549M)
1.00	0.00 to 0.25
0.90	0.26 to 0.50
0.70	0.51 to 0.75
Reject	0.76 to 1.00

e. Air Voids:
   1) Basis of evaluation is laboratory compacted samples (not field compacted samples).
   2) Air voids will be mix design target plus or minus one (1) percent.
   3) If test results are not within this Section's limits, options include correction of production procedures or alternate mix design acceptable to Civil Engineer.

D. Non-Conforming Work: Non-conforming work as covered in the General Conditions applies, but is not limited to the following:
   1. Asphalt Paving:
      a. Deficient asphalt paving thickness:
         1) Place additional material over deficient areas. Do not skin patch. Mill for inlay if necessary. Correct deficient asphalt paving thickness at no additional cost to the Owner.
      b. Rejection and Removal of Asphalt Paving:
         1) Remove asphalt paving found defective after installation and install acceptable product at no additional cost to the Owner.
      c. Removal of Asphalt Paving:
         1) Remove spatter, over-coat, or mar at no additional cost to the Owner.
         2) Remove asphalt from borrow pits or gutters at no additional cost to the Owner.

d. Repair of Asphalt Paving:
    1) Repair or replace defective joints, seams, edges at no additional cost to the Owner.

3.05 PROTECTION

A. Tack Coat:
    1. Protect all surfaces exposed to public view from being spattered or marred. Remove any spattering, over-coating, or marring at no additional cost to Owner.
    2. Traffic:
        a. Do not permit traffic to travel over tacked surface until tack coat has cured and dried.

B. Asphalt Paving:
    1. Protect hot mixed asphalt (HMA) pavement from traffic until mixture has cooled enough not to become marked.

3.06 CLEANING

A. Waste Management:
    1. Pre-emergent herbicide:
        a. Follow Manufacturer's recommendations for disposal of product at approved waste disposal facility.
            1) Do not reuse empty containers.

END OF SECTION 32 1216

SECTION 32 1313

CONCRETE PAVING AND SITE ELEMENTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools and services required to fully complete all Concrete Paving work as required by the Drawings and/or specified herein including, but not limited to, the following described items
   1. Driveways and roadways.
   2. Curbs and flat drainage gutters.
   3. Walkways.
   4. Mow strips
   5. Decorative fence piers and supports.
   6. Light pole bases
   7. Flag pole bases.

1.02 RELATED REQUIREMENTS

A. Division 03 Section "Cast-in-Place Concrete" for general building applications of concrete.

B. Division 31 Section "Earth Moving" for subgrade preparation, grading, and subbase course.

1.03 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag.

1.04 SUBMITTALS

A. Product Data: For each type of manufactured material and product indicated.

B. Shop Drawings: Joint layout plan for written approval before starting work on this Section.

C. Design Mixtures: For each concrete pavement mixture. Include alternate mixture designs when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

D. Qualification Data: For manufacturer.

E. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated, based on comprehensive testing of current materials:
   1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.

F. Material Certificates: Signed by manufacturers certifying that each of the following materials complies with requirements:
   1. Cementitious materials.
   2. Steel reinforcement and reinforcement accessories.
   3. Fiber reinforcement.
   4. Admixtures.
   5. Curing compounds.
   6. Bonding agent or epoxy adhesive.

7. Joint fillers.

G. Field quality-control test reports.

H. Minutes of preinstallation conference.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products who complies with ASTM C 94/C 94M requirements for production facilities and equipment.
   1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

B. ACI Publications: Comply with ACI 301, "Specification for Structural Concrete," unless modified by requirements in the Contract Documents.

C. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

D. Mockups: Cast mockups of full-size sections of concrete pavement to demonstrate typical joints, surface finish, texture, color, and standard of workmanship.
   1. Build mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
   2. Notify Architect seven days in advance of dates and times when mockups will be constructed.
   3. Obtain Architect's approval of mockups before starting construction.
   4. Maintain approved mockups during construction in an undisturbed condition as a standard for judging the completed pavement.
   5. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."
   1. Before submitting design mixtures, review concrete pavement mixture design and examine procedures for ensuring quality of concrete materials and concrete pavement construction practices. Require representatives, including the following, of each entity directly concerned with concrete pavement, to attend conference:
      a. Contractor's superintendent.
      b. Independent testing agency responsible for concrete design mixtures.
      c. Ready-mix concrete producer.
      d. Concrete pavement subcontractor.

1.06 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

B. Do not perform work during unfavorable conditions as specified below:
   1. Temperature below 50 deg F unless cold weather mitigation procedures based on ACI 306.1 are approved by the Architect in advance.
   2. Presence of free surface water.
   3. Over-saturated base and sub-base materials.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Products: Subject to compliance with requirements, provide one of the products specified.
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces.
   1. Use flexible or curved forms for curves with a radius 100 feet or less.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

2.03 STEEL REINFORCEMENT

A. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.

B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.

C. Joint Dowel Bars: Plain steel bars, ASTM A 615/A 615M, Grade 60. Cut bars true to length with ends square and free of burrs.

D. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete, and as follows:
   1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.

2.04 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source throughout the Project:
   1. Portland Cement: ASTM C 150, Type I/II, white. Supplement with the following:
      a. Fly Ash: ASTM C 618, Class C or F.

B. Normal-Weight Aggregates: ASTM C 33, Class 4S coarse aggregate, uniformly graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar pavement applications and service conditions using similar aggregates and cementitious materials.
   1. Road Base type gravel or crushed rock, graded as follows:
      a. Sieve — Percent by Weight Passing Sieve

Sieve	Percent by Weight Passing Sieve
1 inch	100
3/4 inch	85 - 100
No. 4	45 - 60
No. 10	30 - 50
No. 200	5 - 10 (non-plastic)

C. Water: ASTM C 94/C 94M.

D. Air-Entraining Admixture: ASTM C 260.

E. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.
   1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
   2. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
   3. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
   4. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
   5. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.05 FIBER REINFORCEMENT

A. Synthetic Fiber: Monofilament polypropylene fibers engineered and designed for use in concrete pavement, complying with ASTM C 1116, Type III, 1/2 to 1-1/2 inches long.
   1. Products:
      a. Monofilament Fibers:
         1) Axim Concrete Technologies; Fibrasol IIP.
         2) Euclid Chemical Company (The); Fiberstrand 100.
         3) FORTA Corporation; Forta Mono.
         4) Grace, W. R. & Co.--Conn.; Grace MicroFiber.
         5) Metalcrete Industries; Polystrand 1000.
         6) SI Concrete Systems; Fibermix Stealth.
         7) Novomesh

2.06 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Concrete Densifier
   1. Ashford Formula ; https://ashfordformula.com

E. Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to fresh concrete.
   1. Products:
      a. Axim Concrete Technologies; Cimfilm.
      b. Burke by Edeco; BurkeFilm.
      c. ChemMasters; Spray-Film.
      d. Conspec Marketing & Manufacturing Co., Inc.; Aquafilm.
      e. Dayton Superior Corporation; Sure Film.
      f. Euclid Chemical Company (The); Eucobar.
      g. Kaufman Products, Inc.; Vapor Aid.
      h. Lambert Corporation; Lambco Skin.
      i. L&M Construction Chemicals, Inc.; E-Con.
      j. MBT Protection and Repair, ChemRex Inc.; Confilm.
      k. Meadows, W. R., Inc.; Sealtight Evapre.
      l. Metalcrete Industries; Waterhold.
      m. Nox-Crete Products Group, Kinsman Corporation; Monofilm.
      n. Sika Corporation, Inc.; SikaFilm.

o. Symons Corporation; Finishing Aid.
p. Vexcon Chemicals, Inc.; Certi-Vex EnvioAssist.

F. White Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type 2, Class B.
1. Products:
a. Anti-Hydro International, Inc.; AH Curing Compound #2 WP WB.
b. Burke by Edoco; Resin Emulsion White.
c. ChemMasters; Safe-Cure 2000.
d. Conspec Marketing & Manufacturing Co., Inc.; W.B. Resin Cure.
e. Dayton Superior Corporation; Day-Chem White Pigmented Cure (J-10-W).
f. Euclid Chemical Company (The); Kurez VOX White Pigmented.
g. Kaufman Products, Inc.; Thinfilm 450.
h. Lambert Corporation; Aqua Kure-White.
i. L&M Construction Chemicals, Inc.; L&M Cure R-2.
j. Meadows, W. R., Inc.; 1200-White.
k. Symons Corporation; Resi-Chem White.
l. Tamms Industries, Inc.; Horncure 200-W.
m. Unitex; Hydro White.
n. Vexcon Chemicals, Inc.; Certi-Vex Enviocure White 100.

2.07 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.
1. 1/2 inch thick.
2. Manufactured commercial fiber type:
a. Acceptable Products:
1) Conflex by Masonite Building & Industrial Products Group
2) Sealtight by W R Meadows Inc
3) Equal as approved by Architect before installation. See Section 01 6000.

B. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

C. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to requirements, and as follows:
1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.08 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete determined by either laboratory trial mixes or field experience.
1. Use a qualified independent testing agency for preparing and reporting proposed concrete mixture designs for the trial batch method.

B. Proportion mixtures to provide normal-weight concrete with the following properties:
1. Compressive Strength (28 Days): 4000 psi.
2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.44.
3. Slump Limit: 4 inches, plus or minus 1 inch.

C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:
1. Air Content: 6-1/2 percent plus or minus 1 percent for 1-inch nominal maximum aggregate size.

D. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

E. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.
   1. Use water-reducing admixture high-range, high-range, water-reducing and retarding admixture, and plasticizing and retarding admixture in concrete, as required, for placement and workability.
   2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

F. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 requirements for concrete exposed to deicing chemicals. as follows:
   1. Fly Ash or Pozzolan: 20 percent.

G. Synthetic Fiber: Add to concrete truck on site at mix rate specified on plans or per manufactures recommendations.

2.09 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M and ASTM C 1116. Furnish batch certificates for each batch discharged and used in the Work.
   1. When air temperature is between 85 deg F and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Proof-roll prepared subbase surface below concrete pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding.
   1. Completely proof-roll subbase in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph.
   2. Proof-roll with a loaded 10-wheel tandem-axle dump truck weighing not less than 15 tons.
   3. Subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch require correction according to requirements in Division 31 Section "Earth Moving."
   4. Verify that compactness is 95 percent minimum density as determined by ASTM D 1557.

C. Proceed with concrete pavement operations only after nonconforming conditions have been corrected and subgrade is ready to receive pavement.

3.02 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.03 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

C. Form vertical surfaces full depth. Do not allow concrete to flow out from under forms in any degree.

3.04 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

D. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

E. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch overlap of adjacent mats.

3.05 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edgings true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.
   1. When joining existing pavement, place transverse joints to align with previously placed joints, unless otherwise indicated.
   2. Align joints of sidewalk and curb and gutter and concrete pavement.

B. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour unless pavement terminates at isolation joints.
   1. Continue steel reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of pavement strips, unless otherwise indicated.
   2. Provide tie bars at sides of pavement strips where indicated.
   3. Butt Joints: Use bonding agent at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
   4. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.
   1. Locate expansion joints at intervals of 50 feet, unless otherwise indicated.
   2. Extend joint fillers full width and depth of joint.
   3. Terminate joint filler not less than 1/4 inch below finished surface if joint sealant is indicated.
   4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
   5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.

6. Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Depth of control joints shall be approximately one quarter of concrete slab thickness, but not less than one inch. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows to match jointing of existing adjacent concrete pavement and concrete site elements:
   1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate groove marks on concrete surfaces.
   2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.
   3. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.
   4. Scored Control Joints Spacing (Unless Indicated Otherwise):
      a. Curbs: 10 feet on center.
      b. Sidewalks: 5 feet on center.
      c. Mow Strips: 5 feet on center.
      d. Flat Drainage Structures: 10 feet on center.
      e. Retaining Walls: 6 feet on center.

E. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.

3.06 CONCRETE PLACEMENT

A. Inspection: Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast in. Notify other trades to permit installation of their work.

B. Remove snow, ice, or frost from subbase surface and reinforcement before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.

E. Do not add water to concrete during delivery or at Project site.

F. Do not add water to fresh concrete after testing.

G. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

H. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
   1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use

only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.

I. Place concrete in two operations; strike off initial pour for entire width of placement and to the required depth below finish surface. Lay welded wire fabric or fabricated bar mats immediately in final position. Place top layer of concrete, strike off, and screed.
   1. Remove and replace concrete that has been placed for more than 15 minutes without being covered by top layer, or use bonding agent if approved by Architect.

J. Screed pavement surfaces with a straightedge and strike off.

K. Commence initial floating using bull floats or darbies to impart an open textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

L. Sidewalks, Exterior Stairs, And Landings:
   1. Slope sidewalks with cross slope of 1/8 to 1/4 inch per ft in direction of intended drainage.
   2. Slope sidewalks away from building one percent minimum.
   3. Do not dust with cement.

M. Mow Strips:
   1. Granular base not necessary under mow strips. Compact subgrade under mow strip to density of undisturbed earth.
   2. Form and cast mow strips in place.
   3. Set top of mow strip 1-1/2 inches above finish grade.
   4. Compact topsoil underneath mow strip to density of undisturbed earth.

N. Light Pole Bases: Install bond breaker consisting of three layers of 30 lb roofing felt between pole base and adjoining sidewalk.

O. Curbs and Gutters: When automatic machine placement is used for curb and gutter placement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing as specified for formed concrete. If results are not approved, remove and replace with formed concrete.

P. When adjoining pavement lanes are placed in separate pours, do not operate equipment on concrete until pavement has attained 85 percent of its 28-day compressive strength.

Q. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
   1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
   2. Do not use frozen materials or materials containing ice or snow.
   3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mix designs.

R. Hot-Weather Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:
   1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.

2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

S. Remove or repair improperly prepared areas as directed by Architect.

3.07 PERFORATIONS AT UNIT PAVER BASE SLABS

A. Form or core-drill holes through slab every 2 feet o.c. in both directions. Clean holes of loose material to allow positive unobstructed water drainage from top of slab to the aggregate base below the slab.
1. Hole Size: 3/4 inch dia.

3.08 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats, or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
1. Medium-to-Fine-Textured Broom Finish: Draw a soft bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture. Edges to be rounded and edger marks removed.
a. Applies to curbs, gutters, sidewalks, mow strips, flat drainage structures, stairs, and miscellaneous concrete site elements.
2. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
a. Applies to exposed portions of light pole bases and flagpole bases.

C. Retaining Walls:
1. Immediately after removing forms, remove joints, marks, bellies, projections, loose materials, and cut back metal ties from surfaces to be exposed.
2. Point up voids with cement mortar, 1:2 mix, and rub exposed surface with carborundum to smooth, even surface.

D. Fence Piers: Provide chamfered edges.

3.09 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306.1 for cold-weather protection.

C. Ashford Formula
1. Follow manufacturer instruction.

D. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

E. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

F. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:
   1. Moist Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
      a. Water.
      b. Continuous water-fog spray.
      c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
   2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
   3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.10 PAVEMENT TOLERANCES

A. Comply with tolerances of ACI 117 and as follows:
   1. Elevation: 1/4 inch.
   2. Thickness: Plus 3/8 inch, minus 1/4 inch.
      a. Finished Base Course Minimum Thickness: 4 inches thick after compaction and true to line and grade within plus or minus 1/4 inch in 10 feet.
      b. Paving Thickness Minimum: 5 inches thick.
   3. Surface: Gap below 10-foot- long, unleveled straightedge not to exceed 1/4 inch.
   4. Lateral Alignment and Spacing of Tie Bars and Dowels: 1 inch.
   5. Vertical Alignment of Tie Bars and Dowels: 1/4 inch.
   6. Alignment of Tie-Bar End Relative to Line Perpendicular to Pavement Edge: 1/2 inch.
   7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Pavement Edge: Length of dowel 1/4 inch per 12 inches.
   8. Joint Spacing: 3 inches.
   9. Contraction Joint Depth: Plus 1/4 inch, no minus.
   10. Joint Width: Plus 1/8 inch, no minus.

3.11 FIELD QUALITY CONTROL

A. Architect’s Observation: To allow Architect's verification of grades and elevations, notify Architect three days minimum before placing concrete for specified concrete site elements.

B. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

C. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
   1. Testing Frequency: Obtain at least 1 composite sample for each 100 cu. yd. or fraction thereof of each concrete mix placed each day.
      a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
   2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mix. Perform additional tests when concrete consistency appears to change.

3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C 39/C 39M; test 1 specimen at 7 days and 2 specimens at 28 days.
    a. A compressive-strength test shall be the average compressive strength from 2 specimens obtained from same composite sample and tested at 28 days.

D. Strength of each concrete mix will be satisfactory if average of any 3 consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

E. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

F. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

G. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.

H. Remove and replace concrete pavement where test results indicate that it does not comply with specified requirements.

I. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.12 REPAIRS AND PROTECTION

A. Remove drips, overspray, improper markings, and paint material tracked by traffic by sand blasting, wire brushing, or other method approved by Architect before performance.

B. Remove and replace concrete pavement that is broken, damaged, or defective or that does not comply with requirements in this Section.

C. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with portland cement concrete bonded to pavement with epoxy adhesive.

D. Protect concrete from damage. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.

E. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 32 1313

SECTION 32 13 14
CONCRETE PAVING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Driveways
   2. Roadways
   3. Parking lots
   4. Curbs and gutters
   5. Walks

1.02 REFERENCE STANDARDS

1.03 RELATED SECTIONS

A. Section 00 31 00 - Available Project Information.

B. Section 01 33 00 - Submittal Procedures.

C. Section 01 40 00 - Quality Requirements.

D. Section 01 60 00 - Product Requirements.

E. Section 03 20 00 - Concrete Reinforcement.

F. Section 03 30 00 - Cast in Place Concrete.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Indicate pavement markings, lane separations, and defined parking spaces. Indicate, with international symbol of accessibility, spaces allocated for people with disabilities.

C. Other Action Submittals:
   1. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

D. Qualification Data: For qualified ready-mix concrete manufacturer.

E. Material Certificates: For the following, from manufacturer:
   1. Cementitious materials.
   2. Steel reinforcement and reinforcement accessories.
   3. Fiber reinforcement.
   4. Admixtures.
   5. Curing compounds.

1.05 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 PRODUCTS

2.01 MATERIALS

A. Form Material: Steel, wood, or other suitable material of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal. Use straight forms, free of distortion and defects. Use flexible spring steel forms or laminated boards to form radius bends as required.

B. Reinforcing Steel: Provide per Section 03 20 00.

C. Concrete and Aggregates: Provide concrete to comply with Section 03 30 00.

D. Water: Potable and complying with ASTM C94/C94M.

E. Joint Fillers: ASTM D1751, 1 inch thick asphalt-saturated cellulosic fiber in preformed strips.

2.02 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned per ACI 301 (ACI 301M), for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.
   1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
   2. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that meet or exceed requirements.

B. Proportion mixtures to provide normal-weight concrete with the following properties:
   1. Compressive Strength (28 Days): 4,500 psi (27.6 MPa)
      a. Curbs, Gutters, and Walks: 4,500 psi (20.7 MPa).
      b. Heavy-Duty Concrete Paving: 4,500 psi (27.6 MPa), 7 inches thick.
      c. Standard Concrete Paving: 4,500 psi (27.6 MPa), 5 inches thick.
   2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.45 unless indicated otherwise.
   3. Slump Limit: 4 inches (102 mm), plus or minus 1 inch (25 mm), unless indicated otherwise.

2.03 CONCRETE MIXING

A. Ready-Mixed Concrete: Comply with Section 03 30 00. Measure, batch, and mix concrete materials and concrete per ASTM C94/C94M. Furnish batch certificates for each batch discharged and used in Work.
   1. When air temperature is between 85 and 90 degrees F (30 and 32 degrees C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 degrees F (32 degrees C), reduce mixing and delivery time to 60 minutes.

PART 3 EXECUTION

3.01 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.02 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations. Install forms to allow continuous progress of Work and so forms can remain in place at least 24 hours after concrete placement.
   1. Provide grade stakes at a minimum spacing of 25 feet. Provide 1/4 inch crown or cross slope in direction indicated on the drawings. Pitch walks as indicated on Drawings and per guidelines of the AHJ. Make adjustments in slopes at walk intersections to provide positive drainage. Install sufficient quantity of forms to allow continuous progress of Work.
   2. Check completed form Work for grade and alignment.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.03 STEEL REINFORCEMENT

A. General: Comply with CRSI (DA4) "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement, and with Sections 03 20 00 and 03 30 00.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

3.04 JOINTS:

A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.
   1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than 1/2 hour unless paving terminates at isolation joints.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.
   1. Locate expansion joints at intervals of 50 feet (15.25 m) unless otherwise indicated.
   2. Extend joint fillers full width and depth of joint.
   3. Terminate joint filler not less than 1/4 inch (6 mm) or more than 1 inch (25 mm) below finished surface if joint sealant is indicated.
   4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
   5. Furnish joint fillers in 1-piece lengths. Where more than 1 length is required, lace or clip joint-filler sections together.

D. Control Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least 1/3 of concrete thickness.
   1. Spacing: Install control joints at a maximum of 15 feet on center.
   2. Grooved Joints: Form control joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4 inch (6 mm) radius. Repeat grooving of control joints after applying surface finishes.

E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4 inch (6 mm) radius. Repeat tooling of edges after applying surface finishes.

3.05 CONCRETE PLACEMENT

A. General: Comply with the requirements of Division 3 Sections for mixing and placing concrete, and as herein specified.

B. Do not place concrete until subbase and forms have been checked for line and grade. Moisten subbase if required to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes and other structures until they are at required finish elevation and alignment.

C. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place. If placement operations are interrupted for more than 1/2 hour, place construction joint.

D. Consolidate concrete per ACI 301 (ACI 301M) by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
   1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.
   2. When adjacent pavement lanes are placed in separate pours, do not operate equipment on concrete until pavement has attained sufficient strength to carry loads without injury.

E. Cold-Weather Placement: Protect concrete Work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:
   1. When air temperature has fallen to or is expected to fall below 40 degrees F (4.4 degrees C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 degrees F (10 degrees C) and not more than 80 degrees F (27 degrees C) at point of placement.
   2. Do not use frozen materials or materials containing ice or snow.
   3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.

F. Hot-Weather Placement: Comply with ACI 301 (ACI 301M) and as follows when hot-weather conditions exist:
   1. Cool ingredients before mixing to maintain concrete temperature below 90 degrees F (32 degrees C) at time of placement. Chilled mixing water or chopped ice may be used to control

temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.

2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.06 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

1. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.

3.07 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

1. Comply with ACI 306.1 for cold-weather protection.
2. Provide protection to maintain allowable temperatures for a minimum of 5 days after placement.
3. Replace concrete damaged by frost action at no additional cost to Owner.

B. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows and as indicated in Section 03 30 00. Use moist-curing methods for initial curing whenever possible.

1. Moisture Curing: Keep surfaces continuously moist for not less than 7 days with the following materials:
   a. Water.
   b. Continuous water-fog spray.
   c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12 inch (305 mm) lap over adjacent absorptive covers.
2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover, placed in widest practicable width, with sides and ends lapped at least 12 inches (305 mm) and sealed by waterproof tape or adhesive. Immediately repair any holes or tears occurring during installation or curing period using cover material and waterproof tape.

3.08 PAVEMENT TOLERANCES

A. Comply with tolerances of ACI 117 and as follows, unless indicated otherwise:

1. Elevation: 3/4 inch (19 mm).
2. Thickness: Plus 3/8 inch (10 mm), minus 1/4 inch (6 mm).
3. Surface: Gap below 10 foot (3 m) long, unleveled straightedge not to exceed 1/2 inch (13 mm).
4. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches (13 mm per 300 mm) of tie bar.
5. Lateral Alignment and Spacing of Dowels: 1 inch (25 mm).
6. Vertical Alignment of Dowels: 1/4 inch (6 mm).
7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches (6 mm per 300 mm) of dowel.
8. Joint Spacing: 3 inches (75 mm).
9. Contraction Joint Depth: Plus 1/4 inch (6 mm), no minus.
10. Joint Width: Plus 1/8 inch (3 mm), no minus.

3.09 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.

B. Allow concrete paving to cure for a minimum of 28 days and be dry before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

D. Apply paint with mechanical equipment to produce markings of dimensions indicated with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils (0.4 mm).

1. Apply graphic symbols and lettering with paint-resistant, die-cut stencils, firmly secured to concrete surface. Mask an extended area beyond edges of each stencil to prevent paint application beyond stencil. Apply paint so that it cannot run beneath stencil.

3.10 REPAIRS AND PROTECTION

A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove Work in complete sections from joint to joint unless otherwise approved by Architect.

B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.

C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than 2 days before date scheduled for Substantial Completion inspections.

END OF SECTION

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SECTION 32 14 00
UNIT PAVING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Concrete pavers set in aggregate setting beds.
   2. Joint sand.
   3. Plastic edge restraints.
   4. Cast-in-place concrete edge restraints.

1.02 RELATED SECTIONS

A. Section 00 31 00 - Available Data, including Geotechnical Report.

B. Section 01 33 00 - Submittal Procedures.

C. Section 01 40 00 - Quality Requirements.

D. Section 01 60 00 - Product Requirements.

E. Section 32 13 13 - Concrete Paving.

1.03 SUBMITTALS

A. Product Data: For the following:
   1. Pavers.
   2. Edge restraints.
   3. Paver Joint Sand.

B. Sieve Analyses: For aggregate setting-bed materials, according to ASTM C136.

C. Samples for Verification:
   1. Full-size units of each type of unit paver indicated.
   2. Joint materials.
   3. Exposed edge restraints.

D. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.
   3. See Sections 01 33 00 and 01 60 00.

1.04 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of unit paver, joint material, and setting material from single source with resources to provide materials and products of consistent quality in appearance and physical properties.

B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store pavers on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied.

B. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

1.06 PROJECT CONDITIONS

A. Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit paver work damaged by frost or freezing.

1.07 WARRANTY

A. Manufacturer to supply a 3 year product warranty for concrete paver and concrete edger products.

B. The use of deicer on the pavers shall not void the manufacturer's warranty.

PART 2 PRODUCTS

2.01 CONCRETE PAVERS

A. Concrete Pavers: Solid paving units complying with ASTM C936 and resistant to freezing and thawing when tested per ASTM C67, made from normal-weight aggregates.
   1. Approved Manufacturers: (Submit samples to match specified paving unit for architect approval match Architect's sample.)
      a. Belgard
         (Oldcastle Architectural, Inc.)
         375 Northridge Road, Suite 350
         Atlanta, GA 30360
         (800) 899-8455
         (770) 804-3363
         (770) 804-3369 (Fax)
         E-mail: belgard@oldcastleapg.com
      b. No substitutions.
   2. Products:
      a. PV-1 - Pool Deck and Paver Walkways:
         1) Pavers: Cambridge Cobble.
         2) Thickness: 2-3/8 inches (60 mm). (at all pedestrian traffic areas)
         3) Face Size and Shape: 6-by-9-inch (152-by 250-mm) rectangle & 6-by-6 square.
         4) Color: Texas Hill Country.
            (a) Approved Alternatives: Ontario Blend and Light Monticeto.
         5) Pattern: "I-Pattern."
      b. PV-2 - Entry Plaza:
         1) Pavers: Cambridge Cobble.
         2) Thickness: 2-3/8 inches (60 mm). (at all pedestrian traffic areas)
         3) Face Size and Shape: 6-by-9-inch (152-by 250-mm) rectangle & 6-by-6 square.
         4) Color: Fossil Beige.
            (a) Approved Alternatives: Silex Gray and Victorian.
         5) Pattern: "I-Pattern
      c. PV-2A - Pavers in Drive areas:
         1) Pavers: Cambridge Cobble.
         2) Thickness: 3 1/8 inches.
         3) Face Size and Shape: 6-by-9-inch (152-by 250-mm) rectangle & 6-by-6 square.
         4) Color: Fossil Beige.
            (a) Approved Alternatives: Silex Gray and Victorian.
         5) Pattern: "I-Pattern."

B. Concrete Edger: Solid concrete units complying with ASTM C936 and resistant to freezing and thawing when tested per ASTM C67, made from normal-weight aggregates.
   1. Manufacturer: (Submit samples to match specified paving unit for architect approval match Architect's sample.)
      a. Belgard – Oldcastle, Inc.
      b. No Substitutions.
   2. Products:

a. Edger: Valletta Edger.
b. Thickness: 4 ½" x 3 ½" x 8" and 12".
c. Color: To match adjacent deck paver.
d. Location: All landscape edging on outdoor pool deck and along sidewalks.

3. Samples: Submit samples to match specified paving unit for architect approval.

2.02 CURBS AND EDGE RESTRAINTS

A. Plastic Edge Restraints: 1-piece high density polyethylene (HDPE) edging with spikes every 4 inches on center.
   1. Manufacturer:
      Snap Edge Corporation
      3925 Stern Avenue
      Charles, IL 60124
      (800) 932-3343
   2. No Substitutions.

2.03 ACCESSORIES

A. Compressible Foam Filler: Preformed strips complying with ASTM D1056, Grade 2A1.

2.04 AGGREGATE SETTING-BED MATERIALS

A. Graded Aggregate for Subbase: Sound, crushed stone or gravel complying with requirements in Division 31 for subbase material.

B. Graded Aggregate for Base: Sound, crushed stone or gravel complying with requirements in Division 31 for base course.

C. Sand for Leveling Course: Sound, sharp, washed, natural sand or crushed stone complying with gradation requirements in ASTM C33 for fine aggregate.
   1. Sieve per ASTM C136 and CSA-A23.2A.
   2. Conform to the grading requirements of Table 2, Grading Requirements for Bedding Sand, ASTM C33 and CSA A23.1-M94.

D. Sand for Joints: Fine, sharp, washed, natural sand or crushed stone with 100 percent passing No. 16 (1.18-mm) sieve and no more than 10 percent passing No. 200 (0.075-mm) sieve.
   1. Techni-Seal HP Next Gel Polymeric Sand; dry mix, containing polymeric binding agent, activated with water.
   2. Color: To match adjacent paver unit. Submit color samples to architect for approval from manufacturer's full range of color options.
   3. Herbicide: Commercial chemical for weed control, registered with the EPA. Provide in granular, liquid, or wettable powder form.

2.05 COMPRESSIVE STRENGTH

A. At the time of delivery to the work site, the average compressive strength of the paver shall not be less than 8,000 psi, with no individual unit less than 7,200 psi. Testing procedures shall be in accordance with ASTM C140 specifications.

2.06 ABSORPTION

A. The average absorption shall not be greater than five percent (5%), with no individual unit result greater than seven percent (7%) per ASTM C140 specifications.

2.07 RESISTANCE TO FREEZING AND THAWING

A. The manufacturer shall satisfy the purchaser by laboratory testing that the paving units have adequate resistance to freezing and thawing per ASTM C67-83 specifications. The specimens shall have no breakage and not greater than one percent (1%) loss in dry weight of any individual unit when subjected to 50 cycles of freezing and thawing.

2.08 DIMENSIONAL TOLERANCES

A. Pavers shall be prismatic in plan and formed with straight, uniform edges. The tolerance for the flat portions of the sides shall not exceed 1/32" as measured with a steel straight edge. "Slumped" pavers

exceeding this tolerance will be rejected. The length, width and thickness of the paving stones shall meet the allowable tolerances specified in ASTM C936.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas indicated to receive paving, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Remove substances from concrete substrates that could impair mortar bond, including curing and sealing compounds, form oil, and laitance.

B. Sweep concrete substrates to remove dirt, dust, debris, and loose particles.

C. Proof-roll prepared subgrade according to requirements in Division 2 Section "Earthwork" to identify soft pockets and areas of excess yielding. Proceed with unit paver installation only after deficient subgrades have been corrected and are ready to receive subbase and base course for unit pavers.

3.03 INSTALLATION, GENERAL

A. Do not use unit pavers with chips, cracks, voids, discolorations, or other defects that might be visible or cause staining in finished work.

B. Mix pavers from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.

C. Cut unit pavers with motor-driven masonry saw equipment to provide clean, sharp, unchipped edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible. Hammer cutting is not acceptable.
   1. For concrete pavers, a block splitter may be used.

D. Handle protective-coated brick pavers to prevent coated surfaces from contacting backs or edges of other units. If, despite these precautions, coating does contact bonding surfaces of brick, remove coating from bonding surfaces before setting brick.

E. Joint Pattern: “I-Pattern”.

F. Tolerances: Do not exceed 1/32-inch (0.8-mm) unit-to-unit offset from flush (lippage) nor 1/8 inch in 10 feet (3 mm in 3 m) from level, or indicated slope, for finished surface of paving.

G. Expansion and Control Joints: Provide for sealant-filled joints at locations and of widths indicated. Provide compressible foam filler as backing for sealant-filled joints unless otherwise indicated; where unfilled joints are indicated, provide temporary filler until paver installation is complete. Install joint filler before setting pavers. Sealant materials and installation are specified in Division 7 Section "Joint Sealants."

H. Provide edge restraints as indicated. Install edge restraints before placing unit pavers.
   1. Install edge restraints to comply with manufacturer's written instructions. Install stakes at intervals required to hold edge restraints in place during and after unit paver installation.

I. Provide steps made of pavers as indicated. Install paver steps before installing adjacent pavers.

3.04 AGGREGATE SETTING-BED APPLICATIONS

A. Place separation geotextile over prepared subgrade, overlapping ends and edges at least 12 inches (300 mm).

B. Place leveling course and screed to a thickness of 1 to 1-1/2 inches (25 to 38 mm), taking care that moisture content remains constant and density is loose and uniform until pavers are set and compacted.

C. Treat leveling course with herbicide to inhibit growth of grass and weeds.

D. Set pavers with a minimum joint width of 1/16 inch (1.5 mm) and a maximum of 1/8 inch (3 mm), being careful not to disturb leveling base. If pavers have spacer bars, place pavers hand tight against

spacer bars. Use string lines to keep straight lines. Fill gaps between units that exceed 3/8 inch (10 mm) with pieces cut to fit from full-size unit pavers.

1. When installation is performed with mechanical equipment, use only unit pavers with spacer bars on sides of each unit.

E. Vibrate pavers into leveling course with a low-amplitude plate vibrator capable of a 3500- to 5000-lbf (16- to 22-kN) compaction force at 80 to 90 Hz. Use vibrator with neoprene mat on face of plate or other means as needed to prevent cracking and chipping of pavers. Perform at least three passes across paving with vibrator.

1. Compact pavers when there is sufficient surface to accommodate operation of vibrator, leaving at least 36 inches (900 mm) of un-compacted pavers adjacent to temporary edges.
2. Before ending each day's work, compact installed concrete pavers except for 36-inch (900 mm) width of un-compacted pavers adjacent to temporary edges (laying faces).
3. As work progresses to perimeter of installation, compact installed pavers that are adjacent to permanent edges unless they are within 36 inches (90 mm) of laying face.
4. Before ending each day's work and when rain interrupts work, cover pavers that have not been compacted and cover leveling course on which pavers have not been placed with non-staining plastic sheets to protect them from rain.

F. Spread dry sand and fill joints immediately after vibrating pavers into leveling course. Vibrate pavers and add sand until joints are completely filled, then remove excess sand. Leave a slight surplus of sand on the surface for joint filling.

G. Do not allow traffic on installed pavers until sand has been vibrated into joints.

H. Repeat joint-filling process 30 days later.

3.05 REPAIRING, POINTING, AND CLEANING

A. Remove and replace unit pavers that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Provide new units to match adjoining units and install in same manner as original units, with same joint treatment and with no evidence of replacement.

B. Pointing: During tooling of joints, enlarge voids or holes and completely fill with grout. Point joints at sealant joints to provide a neat, uniform appearance, properly prepared for sealant application.

C. Cleaning: Remove excess grout from exposed paver surfaces; wash and scrub clean.

END OF SECTION

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SECTION 32 1723

PAVEMENT MARKINGS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools and services required to fully complete all Pavement Marking work as required by the Drawings and/or specified herein including, but not limited to, the following described items
   1. Furnish material and apply pavement and curb markings as described in Contract Documents.

1.02 REFERENCES

A. Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD)

1.03 QUALITY ASSURANCE

A. Regulatory Requirements: Paint handicap spaces to conform to ADA Standards and local code requirements.

1.04 PROJECT CONDITIONS

A. Project Environmental Requirements:
   1. Apply only on dry surfaces, during favorable weather, and when damage by rain, fog, or condensation not anticipated.
   2. Latex Paint:
      a. Atmospheric temperature above 40 deg F.
      b. When temperature is not anticipated to drop below 40 deg F during drying period.
   3. Alkyd or Chlorinated Rubber Paint:
      a. Atmospheric temperature above 40 deg F.
      b. When temperature is not anticipated to drop below 40 deg F during drying period.

PART 2 - PRODUCTS

2.01 MATERIAL

A. Paint:
   1. Non-reflectorized.
   2. Types:
      a. Acrylic Latex for uncured paving.
      b. Alkyd or chlorinated rubber for cured paving.
   3. Colors:
      a. Yellow: Parking stripes, and safety markings.
      b. White: Crosswalk stripes,
      c. Blue And White: Handicapped markings.
      d. Red: Fire lanes and no parking zones.
   4. Type Two Acceptable Products:
      a. 442XX Traffic Marking Paint by ICI Devoe, Cleveland, OH www.devoepaint.com.
      b. Set-Fast Traffic Marking Paint by Sherwin-Williams, Cleveland, OH www.sherwin-williams.com
      c. Equal as approved by Architect before application. See Section 01 6200.

PART 3 - EXECUTION

3.01 PREPARATION

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.

B. Do not apply acrylic latex system until paving has cured 7 days minimum. Do not apply alkyd or chlorinated rubber systems until paving has cured 3 months minimum.

C. Surfaces shall be dry and free of grease and loose dirt particles. Scrape and wire brush chipped or damaged paint on existing curbs.

D. Perform layout with chalk or lumber crayon only.

3.02 APPLICATION

A. Site Tolerances:
   1. General: Make lines parallel, evenly spaced, and with sharply defined edges.
   2. Line Widths:
      a. Plus or minus 0.25-inch variance on straight segments.
      b. Plus or minus 0.50-inch variance on curved alignments.

B. Provide two coat application, each coat applied at 150 sq ft per gal. Apply second coat after three hours minimum or when first coat is thoroughly dried, whichever is longer.

3.03 CLEANING

A. Remove drips, overspray, improper markings, and paint material tracked by traffic by sand blasting, wire brushing, or other method approved by Architect before performance.

END OF SECTION 32 1723

SECTION 32 18 23
SYNTHETIC FIELD SPORT SURFACING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Outdoor Turf Systems.
   2. Indoor Turf Systems.

1.02 RELATED SECTIONS

A. Section 00 31 00 - Available information (Geotechnical Report)

B. Section 01 31 00 - Project Management and Coordination.

C. Section 01 33 00 - Submittal Procedures.

D. Section 01 40 00 - Quality Requirements.

E. Section 01 60 00 - Product Requirements.

F. Section 32 18 25 - Athletic Surfacing.

1.03 REFERENCES

A. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2016 (Reapproved 2021).

B. ASTM D624 - Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers; 2000 (Reapproved 2020).

C. ASTM D2859 - Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials; 2016 (Reapproved 2021).

D. ASTM F1292 - Standard Specification for Impact Attenuation of Surfacing Materials Within the Use Zone of Playground Equipment; 2022.

E. ASTM F1951 - Standard Specification for Determination of Accessibility of Surface Systems Under and Around Playground Equipment; Current Edition.

1.04 SYSTEM DESCRIPTION – OUTDOOR TURF SYSTEM

A. Performance Requirements: Provide a 2-layer (bottom layer rubber-polyurethane/top layer synthetic grass (without rubber infill) playground surfacing system that has been designed, manufactured and installed to meet the following criteria:
   1. Shock Attenuation (ASTM F1292):
      a. Gmax: Less than 200.
      b. Head Injury Criteria: Less than 1000.
   2. Flammability (ASTM D2859): Pass.
   3. Tensile Strength (ASTM D412): 60 psi (413 kPa).
   4. Tear Resistance (ASTM D624): 140%.
   5. Water Permeability: 0.4 gal/yd2/second.
   6. Accessibility: Comply with requirements of ASTM F1951.

1.05 SYSTEM DESCRIPTION – INDOOR TURF SYSTEM

A. Provide a 2-layer (bottom layer 3mm foam backing/ top layer broadloom tufted filament carpet)

1.06 SUBMITTALS

A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.

B. Product Data: Submit manufacturer’s product data and installation instructions.

C. Verification Samples: Submit manufacturer’s standard verification samples of 9" x 9" (229 mm x 229 mm) minimum.

D. Quality Assurance/Control Submittals: Submit the following:

1. Certificate of qualifications of the playground surfacing installer.

E. Closeout Submittals: Submit the following:
1. Warranty documents specified herein.

1.07 QUALITY ASSURANCE

A. Qualifications: Utilize an installer approved and trained by the manufacturer of the playground surfacing system, having experience with other projects of the scope and scale of the work described in this section.

B. Certifications: Certification by manufacturer that installer is an approved applicator of the playground surfacing system.

1.08 DELIVERY, STORAGE & HANDLING

A. General: Comply with Division 1 Product Requirement Section.

B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

C. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at a minimum temperature of 40 degrees F (4 degrees C) and a maximum temperature of 90 degrees F (32 degrees C).

1.09 PROJECT SITE CONDITIONS

A. Environmental Requirements: Install surfacing system when minimum ambient temperature is 40 degrees F (1 degree C) and maximum ambient temperature is 90 degrees F (32 degrees C). Do not install in steady or heavy rain.

1.10 WARRANTY

A. Project Warranty: Refer to Conditions of the Contract for project warranty provisions.
1. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under contract documents.
2. Warranty Period: 5 years from date of completion of work.

PART 2 PRODUCTS

2.01 TF-1: OUTDOOR TURF SYSTEM

A. Acceptable Manufacturers:
1. Surface America, Inc.
a. Contact: PO Box 157, Williamsville, NY 14231; Telephone: (800) 999-0555, (716) 632-8413; Fax: (716) 632-8324; E-mail: info@surfaceamerica.com; website: http://www.surfaceamerica.com.
2. Xgrass Innovative Turf Solutions.
a. Contact: 242 Duckworth Road, Dalton, GA 30721. Mark Prince Telephone (651)341-7763. mark.prince@xgrass.com.

B. Acceptable Products/Systems.
1. Surface America: PlayBound TurfTop playground surfacing system.
2. Xgrass: Xgrass Rec.

C. Components:
1. Primer:
a. By Manufacturer.
2. Basemat:
a. By Manufacturer.
b. Material: Blend of 100% recycled rubber and polyurethane.
c. Thickness: 2" (51 mm)
3. Synthetic Turf:
a. The synthetic turf material shall be in accordance with the following:

1) The fiber shall be low friction fiber, measuring not less than 1-1/4” high. The low friction fiber shall be specifically designed to virtually eliminate abrasion.
2) The tufted fiber weight shall not be less than 70 ounces per square yard. The fiber shall be tufted on a 3/8" tufting machine at a rate of 3 stitches per inch minimum. The low friction non-abrasive fiber shall be treated with a UV inhibitor.
3) The primary backing shall consist of a one part, two or three component polyester/polypropylene or urethane backing with a minimum weight of 7 ounces per square yard. The secondary backing shall consist of an application of polyurethane (minimum of 20 ounces per square yard); heat activated to permanently lock fiber tufts in place. Products using latex based secondary backings will not be acceptable. The synthetic grass system shall be perforated with 3/16" holes every four (4") inches min in both directions to provide for maximum drainage. Complete synthetic grass system (including base pad) shall drain in excess of 15" per hour. Non-perforated systems shall not be acceptable alternates for purposes of this specification.
4) Granular fill (Optional):
   (a) Provide Granular fill if recommended by manufacturer for application.
   (b) Infill to be Acrylic Coated quartz with anti-Microbial properties. Xgrass Envirofill or equal.
   (c) Color to match turf.
   (d) Crumb rubber infill is not permitted.
5) The turf shall be delivered in Manfacturer's standard widths and lengths best suited for the project.
6) The fiber shall be field green in color to simulate natural grass as closely as possible and treated with UV inhibitor.

b. Boundary lines:
   1) Boundary lines (white) shall be painted as shown on drawings with paint recommended by turf manufacturer.

2.02 TF-2: INDOOR TURF SYSTEM, NON-INFILL (SPORTS SURFACE)

A. Manufacturer: A-Turf.
B. Pile Weight: 55 oz/sy.
C. Face Yarn Type: Polyethylene and nylon.
D. Yarn Size: 5,000 denier polyethylene and 4,400 denier.
E. Pile Height (Finished): 1-1/8”.
F. Color: Green.
G. Construction: Broadloom tufted.
H. Tufting Guage: 1/4”.
I. Primary Backing: TenCate KK TuffBack.
J. Secondary Backing: 22 oz/sy urethane.
K. Finished Roll Width: 12’.
L. Finished Roll Length: up to 120’.
M. Backing: 3mm foam backing pad.
N. Infill: None.

2.03 TF-3: INDOOR TURF SYSTEM, NON-INFILL (ALPHA TRAINING)

A. Manufacturer: Xgrass.
B. Product: Performx Sport 5mm.
C. Pile Height: 9/16”.
D. Backing: 5mm.

E. Fiber Type: Polyethylene.

F. Color: Blend.

G. Roll Width: 15’.

H. Location: Alpha Training.

2.04 MIXES

A. Required mix proportions by weight:

1. Basemat (outdoor turf system): 16+% polyurethane (as ratio: 14% polyurethane divided by 86% rubber). 14% polyurethane, 86% rubber (based on entire rubber & polyurethane mix).

PART 3 EXECUTION

3.01 MANUFACTURER’S INSTRUCTIONS

A. Comply with the instructions and recommendations of the playground surfacing manufacturer.

3.02 EXAMINATION

A. Site Verification of Conditions: Verify that substrate conditions are suitable for installation of the playground surfacing system. New asphalt must be fully cured - up to 30 days. New concrete must be fully cured - up to 7 days.

B. Do not proceed with installation until unsuitable conditions are corrected.

3.03 PREPARATION

A. Surface Preparation:

1. If asphalt or concrete base, using a brush or short nap roller, apply primer to the substrate perimeter and any adjacent vertical barriers such as playground equipment support legs, curbs or slabs that will contact the surfacing system at the rate of 300 ft2/gal (7.5 m2/L).
2. If crushed stone base, must be contained by wood or concrete border, which the material will abut.

B. Remove from the work site and replace material, which has deteriorated, or become contaminated in any way, prior to its application, at no additional expense to this contract. Dispose of waste materials legally, off site.

3.04 INSTALLATION

A. Do not proceed with playground surfacing installation until all applicable site work, including substrate preparation, fencing, playground equipment installation and other relevant work, has been completed.

B. Basemat Installation (outdoor system):

1. Using screeds and hand trowels, install the basemat at a consistent density of 29 pounds, 10 ounces per cubic foot (466 kg/m3) to the specified thickness.
2. Allow basemat to cure for sufficient time so that indentations are not left in the basemat from applicator foot traffic or equipment.
3. Do not allow foot traffic or use of the basemat surface until it is sufficiently cured.

C. Synthetic Turf installation (outdoor system):

1. Rough cut synthetic grass rolls for installation.
2. Using 15" wide seam tape and 1-part urethane adhesive, seam synthetic grass rolls to form monolithic surface. Adhere synthetic grass to basemat around play area perimeter.
3. If infill is included in system, using manual or machine-operated spreading equipment, distribute infill throughout synthetic grass installation to manufacturer's recommended depth.

3.05 PROTECTION

A. Protect the installed playground surface from damage resulting from subsequent construction activity on the site.

END OF SECTION

SECTION 32 18 25
ATHLETIC SURFACING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Recreational and high traffic surface for Outdoor Turf Area stoops.

1.02 RELATED SECTIONS

A. Section 00 31 00 - Available Project Information: Geotechnical Report.

B. Section 01 11 10 - Summary of Work.

C. Section 01 31 00 - Project Management and Coordination.

D. Section 03 30 00 - Cast-in-Place Concrete.

E. Section 32 18 23 - Synthetic Field Sport Surfacing.

1.03 SUBMITTALS

A. Product Data: Manufacturer's descriptive literature for specified cushioned athletic recreational sport coatings.

B. Shop Drawings: Dimensional plans indicating layout of athletic recreational sports coatings.

C. Quality Assurance Submittals: Manufacturer's printed installation instructions.

D. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.
   3. See Sections 01 33 00 and 01 60 00.

1.04 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer: Minimum five (5) years documented experience producing athletic recreational sports coatings similar to those specified.
   2. Installer: Minimum five (5) years documented experience installing athletic recreational sports coatings similar to those specified.

1.05 DELIVERY, STORAGE & HANDLING

A. Acceptance at Site: Ensure materials arrive at the site in unopened and undamaged containers. Do not allow unacceptable materials to be used.

B. Storage: Keep material from freezing, store on pallets in a cool place; never in the hot sun.

1.06 PROJECT CONDITIONS

A. Existing Conditions: Examine areas where materials are to be installed, particularly the sub-base, drainage, compaction and levelness.

B. Ensure area to be surfaced is to be clear of any construction traffic, pedestrian traffic and any obstructions during application.

1.07 WARRANTY

A. Manufacturer's Warranty: Manufacturer's standard warranty against defects in products.

B. Installer's Warranty: Installers standard warranty against defective workmanship.

PART 2 PRODUCTS

2.01 ATHLETIC SURFACING FOR OUTDOOR TURF AREA STOOPS

A. Manufacturer:
   1. Ever Top - Surface America, PO Box 157, Williamsville, NY 14231
      Phone: (800) 999-0555, Fax: 716-64323-8324

B. Materials:
   1. Ever Top Primer Material: Urethane.
   2. Ever Top Flooring Surface:
      a. Material: Blend of recycled EPDM (ethylene propylene diene monomer) rubber and Aromatic urethane binder per manufacturer's recommendations.
      b. Required mix proportions by weight: 22% urethane (ratio: 18% urethane divided by 82% rubber). 18% urethane, 82% rubber (based on entire rubber & urethane mix).
      c. Thickness: Nominal 1/2" (12.7 mm), minimum 3/8" (9.5 mm), maximum 5/8" (15.9 mm).
      d. Custom color created with combination of 4 standard colors: Hunter Green, Bright Green, Dark Grey, and Eggshell - submit sample for review and approval.
   3. Dry Static Coefficient of Friction (ASTM D2047): 1.0.
   4. Wet Static Coefficient of Friction (ASTM D2047): 0.9.
   5. Dry Skid Resistance (ASTM E303): 89.
   6. Wet Skid Resistance (ASTM E303): 57.

C. Concrete Slab Requirements: Minimum thickness, typically 4" for non-weight bearing loads per the standard of the geographic region. 2% slop is recommended with broom finish.

PART 3 EXECUTION

3.01 EXAMINATION

A. Check concrete surfaces for spalling, depressions, cracking and surface irregularities.

B. Installers Examination:
   1. Installer to examine conditions under which construction activities are to be performed, and then submit written notification if such conditions are unacceptable.
   2. Transmit 1 copy of installers report to architect.
   3. Beginning construction activities of this Section indicates installers acceptance of conditions.

3.02 INSTALLATION

A. Install athletic recreational sports surface in accordance with shop drawings and manufacturer's written instructions.

3.03 PROTECTION

A. Protect installed products of this Section from damage to function or finish by subsequent construction activities.

B. Repair minor damage to finishes in accordance with manufacturer's recommendations.

3.04 DEFECTIVE WORK OR MATERIALS

A. Remove from the work site and replace material, which has deteriorated, or become contaminated in any way, prior to its application, at no additional expense to this contract. Dispose of waste materials legally, off site.

END OF SECTION

SECTION 32 31 13
TENNIS, PICKLEBALL FENCES, GATES AND WINDSCREENS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Provision for Racquet Sports as listed:
      a. Tennis.
      b. Pickleball.
   2. Provide all equipment and materials, and do all work necessary to construct the chain link fence and gates, as indicated on the drawings and as specified. Work includes but is not limited to the following:
      a. Vinyl Clad Chain link fencing.
      b. Vinyl Clad Chain link fence fabric.
      c. Polypropylene Wind screen.

1.02 RELATED REQUIREMENTS

A. Examine Contract documents for requirements that affect work of this section. Other specification sections that directly relate to work of this section include, but are not limited to:
   1. Section 00 31 00 - Available Project Information.
   2. Section 01 33 00 - Submittal Procedures.
   3. Section 01 40 00 - Quality Requirements.
   4. Section 01 60 00 - Product Requirements.
   5. Section 03 30 00 - Cast in Place Concrete.
   6. Section 03 38 00 - Post-Tensioned Concrete.
   7. Section 09 65 66 - Resilient Athletic Sports Surface.
   8. Section 31 23 00 - Excavation and Fill.
   9. Section 32 31 15 - Tennis, Pickleball Nets, Posts, Divider Nets and Backdrop Curtains.

1.03 REFERENCE STANDARDS

A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

B. ASTM F1043 - Standard Specification for Strength and Protective Coatings on Steel Industrial Fence Framework; 2018 (Reapproved 2022).

C. CLFMI WLG 2445 - Wind Load Guide for the Selection of Line Post and Line Post Spacing; 2023.

1.04 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design ornamental fences and gates, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Ornamental fence and gate framework shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to ASCE 7.
   1. Post Size/Spacing: 4 inches at pool fence and outdoor child activity fence, 3 inches at patio seating area, and post spacing not to exceed 10 feet (3 m).
   2. Minimum Post Size and Maximum Spacing: Determine according to CLFMI WLG 2445, based on size and pattern specified and on the following:
      a. Wind Loads: Design wind pressures shall be based on Basic Wind Speed, Risk Category and Exposure Category indicated on Structural Drawings.
      b. Fence Height: Varies - Coordinate with Architectural Drawings.
      c. Material Group: Galvanized square steel.

1.05 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fences and gates.
   1. Fence and gate posts, rails, and fittings.
   2. Fabric, reinforcements, and attachments.
   3. Accessories: screen as indicated.
   4. Gates and hardware.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work. Show accessories, hardware, gate operation, and operational clearances.

C. Delegated-Design Submittal: For ornamental fences and gate framework indicated to comply with performance requirements and design criteria, including calculations signed and sealed by the qualified professional engineer responsible for their preparation.

D. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.
   3. See Sections 01 33 00 and 01 60 00.

E. Operation and Maintenance Data.

F. Add special warranty for motorized gate operation.

1.06 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Emergency Access Requirements: Comply with requirements of authorities having jurisdiction for gates serving as a required means of access.

C. Pre-installation Conference: Conduct conference at Project site.
   1. Inspect and discuss electrical roughing-in, equipment bases, and other preparatory work specified elsewhere.
   2. Review sequence of operation for each type of gate operator.
   3. Review coordination of interlocked equipment specified in this Section and elsewhere.

1.07 PROJECT CONDITIONS

A. Field Measurements: Verify layout information for ornamental fences and gates shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

PART 2 PRODUCTS

2.01 FENCING AND CHAIN LINK FABRIC:

A. Height:
   1. Tennis: Height of fence shall be 10'-0" or as specified by Owner or drawings.
   2. Pickleball: Height of fence shall be 10-0" for court perimeter fences, 6'-0" for court divider fences and 3'-6" at low fence areas, or as specified by Owner or drawings.

B. Chain Link Fabric: Chain link fabric shall be 11 gauge galvanized core, finished to 8-gauge when coated. Zinc coating to be minimum of 1.2 oz. per square foot. Extruded bonded polyvinyl chloride coating shall be minimum wall thickness of .015”. The base metal shall have a minimum breaking strength of 850 pounds. Top and bottom selvage of the fabric shall be knuckled with one and three quarters inch (1.25") mesh.

C. Pipe:
   1. Method of Manufacturing: Pipe used for fence framework shall be SS-40, cold formed and welded from steel conforming to ASTM F1043 Group 1C. Exterior and interior surfaces shall receive a hot dip zinc coating of 0.9 oz. per square foot, followed by a chromate conversion

coating per ASTM F1043. The application of the coating will consist of 3.0 mils of cured thermosetting polyester powder coatings.

2. Posts: All posts shall be 2 7/8” OD, with a wall thickness of 0.160”. Steel shall have a minimum yield strength of fifty thousand pounds per square inch (50,000 PSI). Posts for double-drive gates to be 4” OD.
3. Top, Middle and Bottom Rail: Top, middle and bottom rail shall be 1 5/8" OD pipe with a wall thickness of .111” (11 GA) and a minimum yield strength of fifty thousand pounds per square inch (50,000 PSI).
4. Coordinate work with divider net posts. See Section 32 31 15.

D. Reinforcement:
1. Steel x-bracing, above and below fabric, where indicated on drawings.
2. Steel cable with galvanized steel turnbuckles, sized according to local wind conditions.

E. Gates: Construct gate frames with 1 5/8" OD rail material with welded corners. Provide fabric filler same as used in fence, and use 180 degree hinges with lockable latches.
1. Provide gates with dimensions as shown on drawings.
2. Gates designated for wheelchair pickleball shall comply with ADA requirements.

F. Accessories:
1. Fabric Ties: 9 Ga. coated tie-wires.
2. Tension Bands: 2 7/8”, Non-beveled type.
3. Brace Bands: 2 7/8”, Non-beveled type.
4. Eye Tops: Pressed steel, 1 5/8” x 2 7/8”.
5. Dome Tops: 2 7/8” pressed steel.
6. Rail ends: 1 5/8” pressed steel.
7. Line Rail Clamps: 1 5/8” x 2 7/8” for middle and bottom rails.
8. Coating: All fittings to be polyester coated over galvanized finish.

G. Concrete: Concrete shall have twenty-eight (28) day, 4,000 psi compressive strength.

H. Polyvinyl and Powder Coating Color: Black.

2.02 POLYPROPYLENE WIND SCREEN

A. Acceptable Manufacturers and products:
1. Douglas. OMP-9R Open Mesh Poly-Pro Plus Premium Windscreen.
2. Putterman Athletics. Lathe Leno.

B. Fabric: 100% Polypropylene.
1. Windbreak 86% min.

C. Weight: 6oz. per square yard.

D. Tensile Strength: 320 x 180

E. Hems: Reinforced 4-ply Hems with #2 Brass Grommets.

F. Color: Black.

G. Vents: As recommended by Manufacturer.

PART 3 EXECUTION

3.01 FENCING

A. Workmanship: The complete fence shall be plumb, both in line and transverse to the fence, straight and rigid with the fabric tightly stretched and securely fastened.

B. Posts: Post to be no more than 10’ on center. Foundations per design drawings.

C. Rails: Install rails as shown on drawings. Set rails as nearly parallel to the grade as possible and at the specified height.

D. Gates: Gates shall hang plumb and true, and swing easily either direction with no interference. Use lockable fork latches.

E. Fabric: Fabric to be stretched taught to where there is no movement in the mesh when compressed. Top, middle and bottom rail ties to be 12” on center. Posts ties to be 12” on center.

3.02 POLYPROPYLENE WIND SCREEN

A. Install per manufacturer’s written instructions and as indicated on the drawings.

END OF SECTION

SECTION 32 31 15
TENNIS, PICKLEBALL NETS, POSTS, DIVIDER NETS AND BACKDROP CURTAINS

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes nets, posts, divider nets for the following Racquet sports:
   1. Tennis.
   2. Pickleball.

1.02 RELATED REQUIREMENTS

A. Section 01 33 00 - Submittal Procedures.

B. Section 01 40 00 - Quality Requirements.

C. Section 01 60 00 - Product Requirements.

D. Section 03 30 00 - Cast-in-Place Concrete.

E. Section 03 38 00 - Post Tensioned Concrete.

F. Section 09 65 66 - Resilient Athletic Sports Surface (Racquet Sports).

G. Section 32 31 13 - Tennis, Pickleball Fences, Gates and Windscreens.

1.03 REFERENCE STANDARDS

A. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2023, with Errata.

1.04 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design backdrop curtain cabling and anchorage, including comprehensive engineering analysis by a qualified professional engineer. Identify design criteria used. Identify forces imparted to supporting structures so structural adequacy of supports can be verified.

1.05 SUBMITTALS

A. Product Data: Manufacturer’s descriptive literature for specified tennis net posts and net, divider net and backdrop curtain.

B. Shop Drawings: Dimensional plans indicating layout of tennis net posts and net, divider net and backdrop curtain.

C. Delegated-Design Submittal: For Backdrop curtain cabling and anchorage indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation, and licensed to practice in the state the project is in.

D. Quality Assurance Submittals: Manufacturer’s printed installation instructions.

E. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.
   3. See Sections 01 33 00 and 01 60 00.

1.06 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. The Subcontractor must have adequate experience, as well as, a strong working knowledge of the construction methods and materials involved in tennis net posts and net.

1.07 DELIVERY, STORAGE & HANDLING

A. Deliver materials to the job site in good condition and providing proper protection from damage. Materials will be stored with a covering of protective material in a clean-dry location in such a way as to avoid damage.

B. Materials shall also be stored in such a manner to ensure proper ventilation and drainage and to protect against damage, weather, vandalism and theft.

PART 2 PRODUCTS

2.01 MATERIALS

A. Tennis Nets:
   1. Acceptable Manufacturer and products:
      a. Douglas. TN-45.
   2. Material: Double thick 100% polyester.
   3. Weight: 48 oz.
   4. Netting: 3.5mm.
   5. Break Strength: 325 lb.
   6. Warranty: 5 Year Warranty.

B. Tennis Net Posts:
   1. Pipe: Pipe is square outside measurement, 13 gauge, galvanized with a triple coat corrosion protection both inside and out.
   2. Winding Mechanism: The winding mechanism is to be telescopic, non- binding, and operated with a ½" hex head socket. It is to constructed from ½" by 36" long stainless steel threaded rod with a virgin aluminum cast internal loop hook/nut (net fastening device). The ½" stainless steel hex head operating nut is to be recessed in the post cap.
   3. Loop Hook/Nut: The fixed side post is to have a loop hook/nut that accepts the tennis net cable loop.
   4. Cable Capacity: The live and fixed side posts to combine for over 6' of cable take-up capacity.
   5. Post Caps: Virgin aluminum castings.
   6. Finish: The finish is to be electrostatically applied enameled paint, selected from the manufacturer's standard color choices.
   7. Finished Weight: 44 pounds per pair.

C. Pickleball Nets:
   1. Acceptable Manufacturer and products:
      a. Douglas JTN-30
      b. Color: Black.
      c. Material: Braided Polyethylene.
      d. Weight: 14 lbs.
      e. Netting: 1 3/4"

D. Pickleball Net Posts:
   1. Permanent Installation:
      a. Posts:
         1) Douglas, Pickleball Premier RD Post.
            (a) Black #63071.
      b. Line Rail Clamps: 1 5/8" x 2 7/8" for middle and bottom rails.
      c. Coating: All fittings to be polyester coated over galvanized finish.

E. Divider Nets (between interior courts and at end wall):
   1. Divider net supports:
      a. To be attached to Unistrut and clamp to Structure above.
   2. Overall height: 10'-0" AFF.
   3. Netting Material: Vinyl Coated Polyester, 6.5 oz/yd2, 9 x 9 construction, 1000 Denier.
   4. Netting Color: Black.

5. Top Pocket: Dark Green, 18 oz vinyl, 6" with a 1.5" diameter tube.
6. Trim: Dark Green, 18 oz vinyl, 3".
7. Kickplate: Dark Green, 18 oz vinyl 24" Kickplate between courts.
    a. Kickplate shall be hook-and-loop (Velcro) attached.
    b. Kickplate shall bear Life Time logo for the appropriate sport. Coordinate with Owner.
        1) Logo shall be a removeable fabric patch attached to kickplate with velcro. See drawings for size and design.
    c. Furnish Sewn pocket along bottom of kickplate, 6" with a 1.5" diameter tube..
8. Flame Spread: Interior Divider Nets shall meet the flame propagation performance criteria of NFPA 701.
9. Provide required cabling and mounting hardware, and pocket tubing.
10. Optional Doors: 3'-6" x 6'-8" opening, with a 5'-6" flap.
    a. Coordinate with Owner. See drawings for location.
    b. The door shall be made of the same material and include a kick plate to match the divider net.
    c. Door to include Enter and Exit signage, 10" white lettering on black mesh.
    d. Signage and flap shall be hook-and-loop (Velcro) attached.
11. Warranty: 1 year.
12. Acceptable Manufacturers:
    a. Grand Slam Safety.

F. Backdrop curtains:
1. Material: Vinyl 18 oz.
2. Color: Dark Green.
3. Provide 1’x1’ viewing window at all door flaps and Aisle viewing window:
    a. Viewing window mesh shall be an open mesh 22%, High Tenacity Polyester.
4. Kickplate: Dark Green, 18" Kickplate.
    a. Kickplate shall bear Life Time logo for the appropriate sport. Coordinate with Owner.
5. Flame Spread: Interior Backdrop Curtains and Viewing Windows shall meet the flame propagation performance criteria of NFPA 701.
6. Provide required cabling and mounting hardware.
7. Warranty: 1 year.
8. Acceptable Manufacturers:
    a. Grand Slam Safety.

PART 3 EXECUTION

3.01 PREPARATION

A. Layout of the net posts and net, divider net and backdrop curtain shall be carried out in accordance with the construction plans and shop drawings.

B. Any changes or surface irregularities shall be verified and graded.

3.02 INSTALLATION

A. Net posts and net, divider net and backdrop curtain shall be set according to the spaces shown on the drawings. All posts shall be set plumb and level.

END OF SECTION

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SECTION 32 31 19
DECORATIVE METAL FENCES AND GATES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Ornamental fences.
   2. Gates: single swing exit gates and double swing at Trash Enclosure gate.
   3. Hardware.
   4. Screens.
   5. Concrete Piers.
   6. Embed plates.

1.02 RELATED SECTIONS:

A. Section 00 31 00 - Available Project Information.

B. Section 01 33 00 - Submittal Procedures.

C. Section 01 40 00 - Quality Requirements.

D. Section 01 60 00 - Product Requirements.

E. Section 03 20 00 - Concrete Reinforcement.

F. Section 03 30 00 - Cast in Place Concrete.

G. Section 08 71 00 - Door Hardware.

1.03 REFERENCE STANDARDS

A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

C. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2020.

D. ASTM F2408 - Standard Specification for Ornamental Fences Employing Galvanized Steel Tubular Pickets; 2016 (Reapproved 2023).

E. CLFMI WLG 2445 - Wind Load Guide for the Selection of Line Post and Line Post Spacing; 2023.

F. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System; 2012.

1.04 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design ornamental fences, foundations and gates, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated on Structural drawings.

B. Structural Performance: Ornamental fence, foundation and gate framework shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to ASCE 7.
   1. Post Size: 4 inches (at pool fence and outdoor child activity fence), 3” (at patio seating area) and post spacing not to exceed 10 feet (3 m).
   2. Minimum Post Size and Maximum Spacing: Determine according to CLFMI WLG 2445, based on size and pattern specified and on the following:
      a. Wind Loads: Design wind pressures shall be based on Basic Wind Speed, Risk Category and Exposure Category indicated on Structural Drawings.
      b. Fence Height: Varies - Coordinate with Architectural Drawings.
      c. Material Group: Galvanized square steel.

1.05 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for ornamental fences and gates.
   1. Fence and gate posts, rails, and fittings.
   2. Accessories: screen as indicated.
   3. Gates and hardware.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work. Show accessories, hardware, gate operation, and operational clearances.

C. Samples for Verification: Prepared on Samples of size indicated below:
   1. Polyester power coated components: In 6-inch (150-mm) lengths for components and on full-sized units for accessories.

D. Delegated-Design Submittal: For ornamental fences and gate framework indicated to comply with performance requirements and design criteria, including calculations signed and sealed by the qualified professional engineer responsible for their preparation.

E. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.
   3. See Sections 01 33 00 and 01 60 00.

F. Operation and Maintenance Data: Submit O&M manuals according to the requirements of Section 01 92 00 - Facility Operation and Maintenance. For the following to include in emergency, operation, and maintenance manuals:
   1. Polyester power coat finishes.
   2. Gate hardware.

1.06 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Emergency Access Requirements: Comply with requirements of authorities having jurisdiction for gates serving as a required means of access.

C. Pre-installation Conference: Conduct conference at Project site.
   1. Inspect and discuss electrical roughing-in, equipment bases, and other preparatory work specified elsewhere.
   2. Review sequence of operation for each type of gate operator.
   3. Review coordination of interlocked equipment specified in this Section and elsewhere.

1.07 PROJECT CONDITIONS

A. Field Measurements: Verify layout information for ornamental fences and gates shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. Approved Manufacturer:
   1. Iron World
      9390 Davis Ave.
      Howard County, MD 20723.
      Telephone 301-776-7448.
      Fax 301-776-7449.
      www.IronWorldFencing.com

B. Approved Product:
   1. Maverick Industrial Ornamental Picket Fence:
   2. Style: Canterbury – flat top picket.

3. Height: Per drawings.
4. Post Option: 4” square x 11 GA.
5. Picket Option: ¾” square x 18 GA.
6. Color: See drawings and spec section 09 91 00.

2.02 ORNAMENTAL PICKET FENCE

A. Pickets: Galvanized square steel tubular members manufactured per ASTM A653/A653M with a G90 zinc coating 0.90 oz/ft2 and steel to have 45,000 psi (310 Mpa) yield strength. Picket size shall be 3/4” 18 gauge wall thickness, and spaced at 3-1/2” face to face. Pickets shall be attached to rails using ¼” industrial drive rivets.

B. Rails: Horizontal U” channels shall be 1½” x 1 ⅜” x 1 ½” 11 gauge wall thickness (.072”) and galvanized: G90 zinc coating 0.90 oz/ft2. Manufactured per ASTM A653/A653M with a 50,000 psi (344 MPa) yield strength. Rails shall be mechanically punched to receive pickets and drive rivets. Attach rails to brackets using one-way security fastener.

C. Posts: Galvanized square steel tubular members manufactured per ASTM A653/A653M with a G90 zinc coating, 0.90 oz/ ft2. Steel to have 45,000 psi (310 MPa) yield strength. Post are coated with zinc on the inside and outside. Post size options 4” 11 gauge wall thickness.

D. Finish: All posts, caps and fence panels shall be polyester coated individually after fabrication to thoroughly coat all surfaces for additional corrosion protection. All components enter a 5 stage in line cleaning process to prepare the galvanized surfaces for complete adhesion of the finish coat. Components are given a TGIC polyester resin powder coating applied by the electrostatic spray process to 3.0 mil thickness. The finish is baked in an oven for 15 - 20 minutes at a temperature ranging from 400°F.

2.03 ACCESSORIES

A. Post Caps: Aluminum or formed steel manufactured to form a weather-tight closure. Caps shall be sloped style on each post.

B. Rail/Post Brackets: Standard 1½” x 1 ⅜” x 1½”, 11 gauge galvanized steel channels. Cover to be pressed to bracket for permanent installation. Bracket shall be fastened to post with one spray galvanized hex bolt. Rails shall be attached to bracket with one-way security fastener.

C. Pickets shall be secured to rails with ¼” aluminum industrial drive rivets to prevent movement. Rivets have a shear strength of 1,500# and a holding power of 1,100#.

D. Picket Tops: Flat top pickets with plugs.

E. Corrugated Metal Screening: Where indicated on drawings. 25 gauge steel min, conforming to the requirements of ASTM A653 and shall have a hot-dipped galvanized coating designation G-90, zinc coating (0.90 oz/ft²). Iron Curtain or eq.

2.04 SWING GATES

A. General Ornamental Metal Fence: Single swing at exit gates with metal screen on swing gate and at strike side of door to prevent entry from outside of enclosure. Refer to drawings for exact layout and door sizes.

B. Hardware: pressed steel, galvanized, and powder coated.
1. Refer to section 08 71 00 for door hardware.
2. Provide exit devices per drawings and section 08 71 00.

C. General Metal Trash Enclosure Doors: Double swing at Trash Enclosure gate types. Interlocking metal panels with vertical orientation at Trash Enclosure gate. Bolt/pin type door stop to be installed in door and concrete paving to secure door in closed position.

2.05 SETTING MATERIALS

A. Concrete: Minimum 28 day compressive strength of 2,500 psi.

B. Plated Post: Provide 1/2” steel base plates with 4 holes for surface mounting where indicated.

2.06 GROUT AND ANCHORING CEMENT

A. Non-shrink, Nonmetallic Grout: Premixed, factory-packaged, non-staining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout, recommended in writing by manufacturer, for exterior applications.

B. Erosion-Resistant Anchoring Cement: Factory-packaged, non-shrink, non-staining, hydraulic-controlled expansion cement formulation for mixing with potable water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended in writing by manufacturer, for exterior applications.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for a verified survey of property lines and legal boundaries, site clearing, earthwork, pavement work, and other conditions affecting performance of the Work.
   1. Do not begin installation before final grading is completed unless otherwise permitted by Project Manager.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet (152.5 m) or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

3.03 INSTALLATION, GENERAL

A. Install ornamental fencing to comply with ASTM F2408.
   1. Install fencing on established boundary lines inside property line.

B. Install fence per fence industry standards.

C. Set post uniformly at 8’-0” to 10’-0” on center unless otherwise indicated in drawings.

D. Set posts in concrete having a diameter 4 times the diameter of the post, and 6” deeper than the bottom of the post. Forms are not necessary or recommended.

E. Check each post for vertical and top alignment.

F. Attach panels to brackets using removable bolts.

3.04 ORNAMENTAL FENCE INSTALLATION

A. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacing indicated, in firm, undisturbed soil.

B. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.
   1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.
   2. Concrete Fill: Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.
      a. Exposed Concrete: Extend 2 inches (50 mm) above grade; shape and smooth to shed water.
      b. Concealed Concrete: Top as indicated on Drawings to allow covering with surface material.

3.05 GATE INSTALLATION

A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach screening. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

3.06 FIELD QUALITY CONTROL

A. Grounding-Resistance Testing: Owner will engage a qualified testing agency to perform tests and inspections.
   1. Grounding-Resistance Tests: Subject completed grounding system to a megger test at each grounding location. Measure grounding resistance no fewer than two full days after last trace of precipitation, without soil having been moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural grounding resistance. Perform tests by two-point method according to IEEE 81.
   2. Excessive Grounding Resistance: If resistance to grounding exceeds specified value, notify Project Manager promptly. Include recommendations for reducing grounding resistance and a proposal to accomplish recommended work.
   3. Report: Prepare test reports certified by a testing agency of grounding resistance at each test location. Include observations of weather and other phenomena that may affect test results.

3.07 ADJUSTING

A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

B. Lubricate hardware and other moving parts.

3.08 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's personnel to adjust, operate, and maintain ornamental fences and gates.

END OF SECTION

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SECTION 32 3223

KEYSTONE CONCRETE RETAINING WALL

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work shall consist of designing, furnishing and construction of a KEYSTONE® Retaining Wall System in accordance with these specifications and to the lines, grades, design, and dimensions shown on the plans. No alternate wall systems will be considered.

B. Work includes preparing foundation soil, furnishing and installing leveling pad, unit drainage fill and backfill to the lines and grades shown on the construction drawings.

C. Work includes furnishing and installing geogrid soil reinforcement of the type, size, location, and lengths designated on the construction drawings

D. Equivalent types of retaining walls may be provided by contractors with review and approval by lead Architect and Civil Engineer. Possible equivalent alternatives include Versa-lok, Belgard, Redi-Rock, Verti-Block and Allan Block.

1.02 RELATED SECTIONS

A. Section 02300 (31 00 00) - Earthwork

1.03 REFERNCE DOCUMENTS

A. American Society for Testing and Materials (ASTM)
   1. ASTM C140 Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units
   2. ASTM C1262 Standard Test Method for Evaluating the Freeze- Thaw Durability
   3. ASTM C1372 Standard Specification for Dry-Cast Segmental Retaining Wall Units
   4. ASTM D422 Standard Test Method for Particle-Size Analysis of Soils
   5. ASTM D698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3))
   6. ASTM D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3))
   7. ASTM D3034 Standard Specification for Type PSM Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings
   8. ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
   9. ASTM D4475 Horizontal Shear Strength of Pultruded Reinforced Plastic Rods
   10. ASTM D4476 Flexural Properties of Fiber Reinforced Pultruded Plastic Rods
   11. ASTM D4595 Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method
   12. ASTM D5262 Standard Test Method for Evaluating the Unconfined Tension Creep and Creep Rupture Behavior of Geosynthetics
   13. ASTM D5818 Standard Practice for Exposure and Retrieval of Samples to Evaluate Installation Damage of Geosynthetics
   14. ASTM D6637 Standard Test Method for Determining Tensile Properties of Geogrids by the Single or Multi-Rib Tensile Method
   15. ASTM D6638 Standard Test Method for Determining Connection Strength Between Geosynthetic Reinforcement and Segmental Concrete Units (Modular Concrete Blocks)
   16. ASTM D6706 Standard Test Method for Measuring Geosynthetic Pullout Resistance in Soil

17. ASTM D6916 Standard Test Method for Determining the Shear Strength Between Segmental Concrete Units (Modular Concrete Blocks)

B. American Association of State Highway and Transportation Officials (AASHTO)
   1. AASHTO M252 Corrugated Polyethylene Drainage Pipe
   2. AASHTO M288 Standard Specification for Geotextile Specification for Highway Applications

1.04 SUBMITTALS/CERTIFICATION

A. Contractor shall submit a Manufacturer's certification, prior to start of work, that the retaining wall system components meet the requirements of this specification and the structure design.

B. Contractor shall submit construction drawings and design calculations for the retaining wall system as prepared and stamped by a Professional Engineer registered in the state of the project. The engineering designs, techniques, and material evaluations shall be in accordance with the Keystone Design Manual.

1.05 QUALITY ASSURANCE

A. Contractor shall submit a list of five (5) previously constructed projects of similar size and magnitude by the wall installer where the specific retaining wall system has been constructed successfully. Contact names and telephone numbers shall be listed for each project.

B. Contractor shall provide evidence that the design engineer has a minimum of five years of documented experience in the design for reinforced soil structures. The design engineer shall provide proof of current professional liability insurance with an aggregate coverage limit of not less than $2,000,000.

C. Owner shall provide soil testing and quality assurance inspection during earthwork and wall construction operations. Contractor shall provide quality control testing and inspection during construction. Owner's quality assurance program does not relieve the contractor of responsibility for quality control and wall performance.

1.06 DELIVERY, STORAGE AND HANDLING

A. Contractor shall check all materials upon delivery to assure that the proper type, grade, color, and certification have been received.

B. Contractor shall protect all materials from damage due to job site conditions and in accordance with manufacturer's recommendations. Damaged materials shall not be incorporated into the work.

PART 2 - PRODUCTS

2.01 DEFINITIONS

A. Keystone Unit: a concrete retaining wall element machine made from Portland cement, water, and aggregates.

B. Structural Geogrid: a structural element formed of high tenacity woven/ knitted polyester yarns or high-density polyethylene (HDPE) into a regular network of integrally connected tensile elements with apertures of sufficient size to allow interlocking with surrounding soil, rock, or earth and function primarily as reinforcement.

C. Unit Drainage Fill: drainage aggregate that is placed within and immediately behind the Keystone concrete units.

D. Reinforced Backfill: compacted soil that is placed within the reinforced soil volume as outlined on the plans.

2.02 KEYSTONE CONCRETE RETAINING WALL UNITS

A. Keystone concrete units shall conform to the following architectural requirements:
   1. Face color: the color will be selected by the architect.
   2. Face finish: the finish will be selected by the architect.
   3. Bond configuration: running with bonds nominally located at midpoint of vertically adjacent units, in both straight and curved alignments.
   4. Exposed surfaces of units shall be free of chips, cracks or other imperfections when viewed from a distance of 10 feet (3 m) under diffused lighting.

B. Keystone concrete materials shall conform to the requirements of ASTM C1372 - Standard Specifications for Segmental Retaining Wall Units

C. Keystone concrete units shall conform to the following structural and geometric requirements measured in accordance with ASTM C140 Sampling and Testing Concrete Masonry Units, ASTM D6916 Determining the Shear Strength Between Segmental Concrete Units and ASTM D6638 Determining Connection Strength Between Geosynthetic Reinforcement and Segmental Concrete Units:
   1. Compressive strength: ≥ 3000 psi (21 MPa)
   2. Absorption: ≤ 8 % for standard weight aggregates. Note to Specifier: Select appropriate unit(s) below and delete others.
   3. Keystone Standard Units: a. Width: 18" (457 mm). b. Depth: 18" - 21" (457 - 533 mm), not including rough split face. c. Height: 8" (203 mm). d. Weight: 82 - 114 pounds (37 - 52 kg) per unit minimum using standard weight aggregates.
   4. Keystone Compac Units:
      a. Width: 18" (457 mm).
      b. Depth: 12" (305 mm), not including rough split face
      c. Height: 8" (203 mm).
      d. Weight: 67 - 89 pounds (30 - 40 kg) per unit minimum using standard weight aggregates.
   5. Keystone Century Wall Units:
      a. Width: Varies – 7 - 18" (178 - 457 mm).
      b. Depth: 12" (305 mm) minimum, not including rough split face.
      c. Height: 8" (203 mm) and 4" (101 mm).
      d. Weight: 20 - 87 pounds (9 - 39 kg) per unit minimum using standard weight aggregates.
   6. Keystone Country Manor Units:
      a. Width: 4" - 16" (101 - 406 mm).
      b. Depth: 10" (254 mm) minimum, not including rough split face.
      c. Height: 6" (152 mm).
      d. Weight: 21 - 65 pounds (10 - 29 kg) per unit minimum using standard weight aggregates.
   7. Accessory Units: Provide matching units.
      a. Corners: Provide 90 degree corners, finished two sides, where indicated.
      b. Cap units: Provide solid cap units.

D. Keystone concrete units shall conform to the following construction requirements:
   1. Vertical setback: 1/8" (3 mm) ± per course (near vertical) or 1" (25 mm) + per course per the design;
   2. Alignment and grid positioning mechanism fiberglass pins, two per unit minimum (one pin for small units).
   3. Maximum horizontal gap between erected units shall be ≤ 1/2" (13 mm).

2.03 SHEAR CONNECTORS

A. Shear connectors shall be 1/2" (12 mm) diameter thermoset isopthalic polyester resin pultruded fiberglass reinforcement rods to provide connection between vertically and horizontally adjacent units with the following requirements:
   1. Flexural Strength in accordance with ASTM D4476: 128,000 psi (882 MPa) minimum;
   2. Short Beam Shear in accordance with ASTM D4475: 6,400 psi (44 MPa) minimum

B. Shear connectors shall be capable of holding the geogrid in the proper design position during grid pre tensioning and backfilling.

2.04 BASE LEVELING PAD MATERIAL

A. Material shall consist of a compacted crushed stone base or non-reinforced concrete as shown on the construction drawings.

2.05 UNIT DRAINAGE FILL

A. Unit drainage fill shall consist of clean 1" (25 mm) minus crushed stone or crushed gravel meeting the following gradation tested in accordance with ASTM D422:

Sieve Size	Percent Passing
1" (25 mm)	100
3/4" (19 mm)	75 - 100
No. 4 (4.75mm)	0 -10
No. 50 (300um)	0 – 5

B. Drainage fill shall be placed within the cores of, between, and behind the units as indicated on the design drawings. Not less than one cubic foot (0.028 m3), of drainage fill shall be used for each square foot (0.093 m2) of wall face unless otherwise specified.

2.06 REINFORCED BACKFILL

A. Reinforced backfill shall be free of debris and organic material; meeting the following gradation tested in accordance with ASTM D422:

Sieve Size	Percent Passing
3/4" (19 mm)	100-75
No. 4 (425mm)	0 - 60
No. 200 (75um)	0 – 35

A. The maximum aggregate size shall be limited to 3/4" (19 mm) unless field tests have been performed to evaluate potential strength reductions to the geogrid design due to damage during construction.

B. Material can be site-excavated soils where the above requirements can be met. Unsuitable soils for backfill (high plastic clays or organic soils) shall not be used in the backfill or in the reinforced soil mass.

C. Contractor shall submit reinforced fill sample and laboratory test results to the Architect/Engineer for approval prior to the use of any proposed reinforced fill material.

2.07 GEOGRID SOIL REINFORCEMENT

A. Geosynthetic reinforcement shall consist of geogrids manufactured specifically for soil reinforcement applications and shall be manufactured from high tenacity polyester yarn or high density polyethylene. Polyester geogrid shall be knitted from high tenacity polyester filament yarn with a molecular weight exceeding 25,000 g/m and a carboxyl end group values less than 30. Polyester geogrid shall be coated with an impregnated PVC coating that resists peeling, cracking, and stripping.

B. Ta, Long Term Allowable Tensile Design Load, of the geogrid material shall be determined as follows:

Ta = Tult / (RFcr*RFd*RFid*FS) Ta shall be evaluated based on a 75-year design life.

1. Tult, Short Term Ultimate Tensile Strength shall be determined in accordance with ASTM D4595 or ASTM D6637. Tult is based on the minimum average roll values (MARV).
2. RFcr, Reduction Factor for Long Term Tension Creep RFcr shall be determined from 10,000-hour creep testing performed in accordance with ASTM D5262 - RFcr can typically vary from 1.40 to 4.0.
3. RFd, Reduction Factor for Durability RFd shall be determined from polymer specific durability testing covering the range of expected soil environments. RFd can typically vary from 1.10 to 2.0.
4. RFid, Reduction Factor for Installation Damage RFid shall be determined from product specific construction damage testing performed in accordance with ASTM D5818. Test results shall be provided for each product to be used with project specific or more severe soil type. RFid can typically vary from 1.05 to 2.0
5. FS, Overall Design Factor of Safety FS shall be 1.5 unless otherwise noted for the maximum allowable working stress calculation.

C. The maximum design tensile load of the geogrid shall not exceed the laboratory tested ultimate strength of the geogrid/facing unit connection divided by a factor of safety of 1.5. The connection strength testing and computation procedures shall be in accordance with ASTM D6638 Connection Strength between Geosynthetic Reinforcement and Segmental Concrete Units.

D. Soil Interaction Coefficient, Ci Ci values shall be determined per ASTM D6706 at a maximum 3/4" (19 mm) displacement.

E. Manufacturing Quality Control The geogrid manufacturer shall have a manufacturing quality control program that includes QC testing by an independent laboratory.

The QC testing shall include:

Tensile Strength Testing
Melt Flow Index (HDPE)
Molecular Weight (polyester)

2.08 DRAINAGE PIPE

A. If required, the drainage pipe shall be perforated or slotted PVC pipe manufactured in accordance with ASTM D3034 or corrugated HDPE pipe manufactured in accordance with AASHTO M252.

2.09 GEOTEXTILE FILTER FABRIC

A. When required, Geotextile filter fabric shall be 4.0 oz/sy, polypropylene, needle-punched nonwoven fabric in accordance with AASHTO M288.

PART 3 - EXECUTION

3.01 EXCAVATION

A. Contractor shall excavate to the lines and grades shown on the construction drawings. Owner's representative shall inspect the excavation and approve the foundation soils prior to placement of leveling material or fill soils

B. Over excavation and replacement of unsuitable foundation soils and replacement with approved compacted fill will be compensated as agreed upon with the Owner.

3.02 BASE LEVELING PAD

A. Leveling pad material shall be placed to the lines and grades shown on the construction drawings, to a minimum thickness of 6" (150 mm) and extend laterally a minimum of 6" (150 mm) in front and behind the Keystone wall unit.

B. Soil leveling pad materials shall be compacted to a minimum of 95% Standard Proctor density per ASTM D698 or 92% Modified Proctor Density per ASTM D1557.

C. Leveling pad shall be prepared to insure full contact to the base surface of the concrete units.

3.03 KEYSTONE UNIT INSTALLATION

A. First course of units shall be placed on the leveling pad at the appropriate line and grade. Alignment and level shall be checked in all directions; insuring that all units are in full contact with the base and properly seated.

B. Place the front of units side-by-side. Do not leave gaps between adjacent units. Layout of corners and curves shall be in accordance with manufacturer's recommendations.

C. Install shear/connecting devices per manufacturer’s recommendations.

D. Place drainage fill within and behind wall units. Place and compact backfill soil behind drainage fill. Follow wall erection and drainage fill closely with structure backfill.

E. Maximum stacked vertical height of wall units, prior to unit drainage fill and backfill placement and compaction, shall not exceed two courses

3.04 STRUCTURAL GEOGRID INSTALLATION

A. Geogrid shall be oriented with the highest strength axis perpendicular to the wall alignment.

B. Geogrid reinforcement shall be placed at the strengths, lengths, and elevations shown on the construction design drawings or as directed by the Engineer.

C. The geogrid shall be laid horizontally on compacted backfill and attached to the Keystone wall units. Place the next course of Keystone concrete units over the geogrid. The geogrid shall be pulled taut, and anchored prior to backfill placement on the geogrid.

D. Geogrid reinforcements shall be continuous throughout their embedment lengths and placed side-by-side to provide 100% coverage at each level. Spliced connections between shorter pieces of geogrid or gaps between adjacent pieces of geogrid are not permitted.

3.05 REINFORCED BACKFILL PLACEMENT

A. Reinforced backfill shall be placed, spread, and compacted in such a manner that minimizes the development of slack in the geogrid and installation damage.

B. Reinforced backfill shall be placed and compacted in lifts not to exceed 6" (150 mm) where hand operated compaction is used, or 8 - 10" (200 to 250 mm) where heavy self-propelled compaction equipment is used. Lift thickness shall be decreased to achieve the required density, as needed.

C. Reinforced backfill shall be compacted to a minimum of 95% Standard Proctor density per ASTM D698 or 92% Modified Proctor Density per ASTM D1557. The moisture content of the backfill material prior to and during compaction shall be uniformly distributed throughout each layer.

D. Only lightweight hand operated equipment shall be allowed within 3 feet (1 m) from the tail of the Keystone concrete unit.

E. Tracked construction equipment shall not be operated directly upon the geogrid reinforcement. A minimum fill thickness of 6" (150 mm) is required prior to operation of tracked vehicles over the geogrid. Tracked vehicle turning should be kept to a minimum to prevent tracks from displacing the fill and damaging the geogrid.

F. At the end of each day's operation, the Contractor shall slope the last lift of reinforced backfill away from the wall units to direct runoff away from wall face. The Contractor shall not allow surface runoff from adjacent areas to enter the wall construction site.

3.06 CAP INSTALLATION

A. Cap units shall be glued to underlying units with an all-weather adhesive recommended by the manufacturer.

3.07 AS-BUILT CONSTRUCTION TOLERANCES

A. Vertical alignment: ± 1.5" (40 mm) over any 10' (3 m) distance.

B. Wall Batter: within 2 degrees of design batter.

C. Horizontal alignment: ± 1.5" (40 mm) over any 10' (3 m) distance. Corners, bends & curves: ± 1 foot (300 mm) to theoretical location.

D. Maximum horizontal gap between erected units shall be ≤ 1/2" (13 mm).

3.08 FIELD QUALITY CONTROL

A. Wall construction shall be monitored by a qualified Engineer to verify field conditions. If this work is not performed by the site geotechnical engineer, the geotechnical engineer shall be consulted in those matters pertaining to soil conditions and wall performance.

B. The foundation soils at each wall location shall be inspected by the Engineer and any unsuitable soils or improperly compacted material shall be removed and replaced as directed by the Engineer pior to wall construction to provide adequate bearing capacity and minimize settlement.

C. All wall excavation and retained soils shall be inspected for groundwater conditions and any additional drainage provisions required in the field shall be incorporated into the wall construction as directed by the Engineer.

D. Wall backfill material shall be tested and approved by the Engineer for use in the reinforced soil zone meeting the minimum requirements of the approved design plans.

E. All soil backfill shall be tested by the Engineer for moisture, density, and compaction periodically (every 2' vertically, 100'-200' c/c) meeting the minimum requirements of the approved design plans or project specifications.

F. Wall construction shall be periodically inspected by the Engineer to ensure the geogrid reinforcement elevations and lengths are installed in accordance with the approved design plans

G. All wall elevations, grades, and backslope conditions shall be verified by the Engineer in the field for conformance with the approved design plans. Any revisions to the structure geometry or design criteria shall require design modification prior to proceeding with construction.

END OF SECTION 32 3223

SECTION 32 33 00
SITE FURNISHINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Bike Racks.

B. Planters:
   1. Concrete Planters.
   2. Modular Metal Planters.

C. Shade Umbrellas.

D. Cabanas.

E. Bench

F. Bike Repair Station

1.02 RELATED SECTIONS:

A. Section 01 33 00 - Submittal Procedures.

B. Section 01 40 00 - Quality Requirements.

C. Section 01 60 00 - Product Requirements.

D. Section 03 30 00 - Cast In Place Concrete.

E. Section 26 56 00 - Exterior Lighting.

F. Section 32 84 00 - Planting Irrigation.

G. Section 32 93 00 - Plants.

1.03 SUBMITTALS

A. Product Data: For each type of product included, provide construction details, material descriptions, dimensions of individual components and profiles, and finishes for bike racks.

B. Shop Drawings: For each type of product indicated:
   1. Shade Umbrellas.
   2. Cabanas.

C. Manufactures' Warranties.
   1. Bike Rack:
      a. Manufacturer's 2 year warranty.
   2. Planters:
      a. Concrete Planter:
         1) Manufacturer's 2 year warranty.
      b. Modular Metal Planters:
         1) Manufacturer's 5 year warranty for metal body.
         2) Manufacturer's 3 year warranty for finishes.
   3. Shade Umbrellas:
      a. Manufacturer's 15 year Warranty for mast, structure and hardware.
      b. Manufacturer's 5 year Warranty for finishes, lift system.
   4. Cabanas:
      a. Manufacturer's 15 year Warranty for frame, roof and supports.
      b. Manufacturer's 5 year Warranty for finishes.

1.04 DELIVERY, STORAGE & HANDLING

A. Acceptance at Site: Ensure materials arrive at the site in unopened and undamaged containers. Packaging, Shipping, Handling and Unloading; Observe manufacturer’s recommendations and handle in a manner to prevent breakage.

B. Time delivery and installation of products to avoid extended on-site storage and to coordinate with work adjacent to installation locations.

C. Storage: Keep material from freezing, Store on pallets in a cool place; never in the hot sun.

1.05 PROJECT CONDITIONS

A. Field Measurements: Verify layout information shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements. Assure structural connections are properly located per plans and per manufacturer's requirements.

PART 2 PRODUCTS

2.01 BIKE RACK

A. Available Manufacturer's: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to the following
   1. Basis of Design: Huntco Supply, LLC. Portland, OR, (800-547-5909) model "BR Plus-X."

B. Model: "Rambler Wide," Seven Bike Capacity.

C. Construction: 2-3/8" OD, 0.154 ASTM A53, Schedule 40 steel pipe, inverted "U" style, 36" to top of the inverted "U", 18" clear between vertical members.

D. Mounting: In-ground (IG) mounting.

E. Finish: Innotek, Polyarmor G17, thermoplastic polyethylene copolymer-based powder coat.

F. Color: Tan "RAL1001."

G. Post: Weldment comprised of 5" O.D. x 11 GA. (.120") stainless steel tubing.

H. Finish: Powdercoat, color to be reviewed and approved by architect.

2.02 PLANTERS

A. Concrete Planters:
   1. Manufacturer: Kornegay Design, Phoenix, AZ (877-252-6323).
   2. Product Line: Larkspur Series
   3. Model: KD-LS-48
   4. Options: Coordinate irrigation holes with Irrigation Plans.
   5. Size: 32" dia., 48" tall (at building entry).
   6. Color: Graphite (Iron Oxide)
   7. URL: https://kornegaydesign.com/solutions/larkspur-planters/

B. Continuous Modular Metal Planters:
   1. Manufacturer: Ore Design, Woods Cross, UT (801-936-0499).
   2. Product Line: FuSE.
   3. Face Material:
      a. Aluminum.
      b. Steel.
      c. Corten Steel.
      d. To be selected by Architect.
   4. Face Finish:
      a. Powder Coat: Charcoal Gray, by Manufacturer.
      b. To be Selected by Architect from Manufacturer's full range.
   5. Cladding Material:
      a. Ipe Wood. (see Section 06 15 00). Coordinate anchorage with other trades.
      b. See Drawings.
   6. Cap Material:
      a. As shown on drawings. Coordinate anchorage with other trades.
   7. Options:
      a. Coordinate irrigation and drainage sleeves with Irrigation Plans.

b. Coordinate lighting with Electrical.
c. Coordinate speakers with Technology.
d. See drawings for additional requirements.

8. Dimensions: As shown on drawings.

2.03 UMBRELLAS

A. Manufacturer: Tuuci.

B. UMB-1:
1. Ocean Master MAX Single Cantilever “easy drive” crank w/ telescoping mast and premium half aluma-crete cube anchor, finished in Java aluma-TEAK:
2. 106” mast height, 90.5” (7’-6 ½”) canopy clearance, mast and all structure finished in Java aluma-TEAK.
3. 10’ x 14’ rectangular shade, Single Vent, Market Profile, Single Panel Color, Binding edge, Crank system. Shade Material: Linen: 4633-000 Marine Grade C.
4. Mounting: Through paver, Concrete-set, In-Ground Security Mount. Confirm finishing plates with Architect and manufacturer.

C. UMB-2:
1. Ocean Master MAX Dual Cantilever “easy drive” crank w/ telescoping mast and premium half aluma-crete cube anchor, finished in Java aluma-TEAK:
2. 107” mast height, 87” (7’-3”) canopy clearance, mast and all structure finished in Java aluma-TEAK.
3. 10’ x 20’ dual rectangular shade, Single Vent, Market Profile, Single Panel Color, Binding edge, Crank system. Shade Material: Linen: 4633-000 Marine Grade C.
4. Mounting: Through paver, Concrete-set, In-Ground Security Mount. Confirm finishing plates with Architect and manufacturer.

D. UMB-3:
1. Ocean Master MAX Dual Cantilever “easy drive” crank w/ telescoping mast and premium half aluma-crete cube anchor, finished in Java aluma-TEAK:
2. 107” mast height, 90” (7’-6”) canopy clearance, mast and all structure finished in Java aluma-TEAK.
3. 8’ x 16’ dual rectangular shade, Single Vent, Market Profile, Single Panel Color, Binding edge, Crank system. Shade Material: Cocoa: 4676-000 Marine Grade C.
4. Mounting: Through paver, Concrete-set, In-Ground Security Mount. Confirm finishing plates with Architect and manufacturer.

E. UMB-4:
1. Ocean Master MAX Dual Cantilever “easy drive” crank w/ telescoping mast and premium half aluma-crete cube anchor, finished in Java aluma-TEAK:
2. 107” mast height, 87” (7’-3”) canopy clearance, mast and all structure finished in Java aluma-TEAK.
3. 13' dual octagonal shade, Single Vent, Market Profile, Single Panel Color, Binding edge, Crank system. Shade Material: Captain Navy. Marine Grade C.
4. Mounting: Through paver, Concrete-set, In-Ground Security Mount. Confirm finishing plates with Architect and manufacturer.

2.04 CABANAS

A. Manufacturer: Tuuci
1. Model: Solanox

B. CABN-1:
1. Frame:
a. Dimensions: 10’ x 12’
b. Finish: Powder coat – Espresso.
2. Roof:
a. Type: Trellis with soft shade fabric solar screen.

b. Horizontal member finish: Powder coat – Espresso.
c. Fabric color: Twitchell Desert Tan.

3. 12’ Back Wall 1:
   a. Type: Trellis.
   b. Finish: Powder coat – Espresso.
4. 10’ Side Wall 2: Full curtains in Sunbrella Canvas Flax #5492.
5. 12’ Front Wall 3: NO WALL.
6. 10’ Side Wall 4: Full curtains in Sunbrella Canvas Flax #5492.
7. Electrical: Outlet & USB included in each cabana, coordinate with electrical for power connection points. Standard outlet and USB location.
8. Mounting: Through-paver, concrete-set security mount IGSM with leveling stainless steel base plate.

2.05 BENCH

A. Available Manufacturer’s: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to the following
   1. Basis of Design: Dumor Site Furnishings

B. Model: 94-60 6’ Steel Bench

C. Construction: Steel members coated with zinc rich epoxy then finished w/ polyester powder coating.

D. Mounting: Surface Mount

E. Color: Carlsbad

F. Finish: Powdercoat, color to be reviewed and approved by architect.

2.06 ULTIMATE BIKE REPAIR STATION

A. Available Manufacturer’s: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to the following
   1. Basis of Design:Barco Products

B. Model: BR-32

C. Construction: Thick-walled DOM tubing

D. Mounting: Flange

E. Finish: Powdercoat

F. Color: Black

G. Finish: Powdercoat, color to be reviewed and approved by architect.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with manufacturers requirements before installation; reject any product with defects.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install bike rack to comply with manufacturer’s written instructions, referenced standards and as indicated.

B. Install planter to comply with manufacturer’s written instructions, referenced standards and as indicated.
   1. Coordinate irrigation, soil and plantings with Landscape Contractor, drawings and specifications.

2. Coordinate lighting and technology features with Electrical and Technology Contractors, drawings and specifications.

C. Transport, Install; and Clean Umbrellas to comply with manufacturer's written instructions, referenced standards and as indicated.

D. Transport; Install, and Clean Cabanas to comply with manufacturer's written instructions, referenced standards and as indicated.
   1. Coordinate lighting and technology features with Electrical and Technology Contractors, drawings and specifications.

3.03 PROTECTION

A. Protect surfaces, edges, and corners from construction damage.

B. Before inspection for Substantial Completion, remove protective coverings and clean surfaces.

3.04 WARRANTY

A. Closeout Submittals: Provide manufacturer's completed warranty form and submit to client.

END OF SECTION

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SECTION 32 35 15
LANDSCAPE SHADE TOPS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Landscape shade tops.

1.02 RELATED SECTIONS:

A. Section 01 33 00 - Submittal Procedures.

B. Section 01 40 00 - Quality Requirements.

C. Section 01 60 00 - Product Requirements.

D. Section 01 92 00 - Facility Operation and Maintenance.

E. Division 3 Section Cast-in-Place Concrete for cast-in-place concrete post footings.

1.03 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00.

1.04 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for Landscape Shade Tops.
   1. Landscape Shade Top fabric, posts, and fittings.
   2. Accessories: None.

B. Material and Color Samples: For pre-finished structural members and shade canopy fabric.

C. Product Certificates: For each type of Landscape Shade Structure, from manufacturer.

D. Product Test Reports:
   1. Framing strength according to ASTM F2408.
   2. Non-Combustible per NFPA 701B.

E. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.
   3. See Sections 01 33 00 and 01 60 00.

F. Operation and Maintenance Data: Submit O&M manuals according to the requirements of Section 01 92 00 - Facility Operation and Maintenance. For the following to include in emergency, operation, and maintenance manuals:
   1. Assembly.
   2. Polyester power coat finishes.

G. Warranty: Sample of special warranty.

1.05 DELIVERY, STORAGE & HANDLING

A. Acceptance at Site: Ensure materials arrive at the site in unopened and undamaged containers.

B. Storage: Keep material from freezing, store on pallets in a cool place; never in the hot sun.

C. Deliver landscape shade tops cardboard-wrapped or crated to provide protection during transit and job storage.

D. Inspect landscape shade tops on delivery for damage. Minor damages may be repaired provided refinished items match new work and are acceptable to the Architect; otherwise, remove and replace damaged items as directed.

1.06 PROJECT CONDITIONS

A. Field Measurements: Verify layout information for Landscape Shade Tops shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to the following
   1. Landscape Structures, Inc.; “CoolToppers” Single Post Shade.
   2. USA Shade and Fabric Structures; Single Post Pyramid Unit.
   3. Or approved substitution.

2.02 CONSTRUCTION

A. Shade Top: High-density polyethylene with ultra-violet additives. All corners to be strengthened with 16 oz. non-tear vinyl material. Protective webbing is sewn into all areas where steel cable enters/exits cloth pockets. Live loads 20.00 psf. Wind design speed to withstand 80 mph. Uplift 18.75 psf. Snow Loads 5.00 psf. Tear strength warp 220.46 lb. and wet 462.97 lb. Burst strength 37.70 PSIA.
   1. Color: Tan. (Desert Sand)
   2. Color at Diamond Pool Reception: Denim. (Navy Blue)

B. Roof Sleeve: Cast from 319 almag.

C. Disc: 1” thick x 10” diameter white high density UV stabilized polyethylene.

D. Extension Arms: Weldment comprised of 2.375” O.D. RS-20 (.095”-.105”) galvanized steel tubing and 5/16” HRPO gusset. Finish: Powdercoat, color: Tan.

E. Post: Weldment comprised of 5” O.D. x 11 GA. (.120”) stainless steel tubing. Finish: Powdercoat, color: Tan.

F. Size: 12 ft by 12 ft.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for landscape shade tops before installation; reject any landscape shade tops with defects.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install landscape shade tops to comply with manufacturer’s written instructions, referenced standards and as indicated.

END OF SECTION

SECTION 32 35 16
OUTDOOR SHADE STRUCTURES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Outdoor Awning Shade Structure.

1.02 RELATED SECTIONS:

A. Section 01 33 00 - Submittal Procedures.

B. Section 01 40 00 - Quality Requirements.

C. Section 01 60 00 - Product Requirements.

D. Section 01 92 00 - Facility Operation and Maintenance.

E. Section 03 30 00 - Cast-in-Place Concrete for cast-in-place concrete post footings.

F. Section 32 31 13 - Tennis/Pickleball Fences Gates and Windscreens, for connections to Tennis/Pickleball Fence.

1.03 DESCRIPTION

A. Work Included: Furnish and install the outdoor shade structures as indicated on the drawings, specified herein, and as necessary for proper completion including, but not necessarily limited to:
   1. Shade fabric top material.
   2. Tension cable and related hardware.
   3. Structural steel support system.
   4. Concrete foundations.
   5. Concrete reinforcement.
   6. Fire resistance.
   7. Fire protection.
   8. Lighting.
   9. Installation supervision.
   10. Labor, material and equipment to complete the installation.
   11. Operations and maintenance manuals.
   12. On site training.

1.04 PERFORMANCE REQUIREMENTS

A. Delegated Design:
   1. Design 100 percent of Awning shade structure, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
      a. Design Awning shade structures under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the state/province of the project.

B. Design Trellis shade system and cable supports to be attached to the structure provided.
   1. Design Trellis shade structures under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the state/province of the project.

1.05 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for Outdoor shade structure.
   1. Outdoor shade structure fabric, posts, and fittings.
   2. Accessories.

B. Samples for Verification:
   1. Shade fabric.
   2. Steel colors.

C. Shop Drawings:
   1. Shade Structure Canopy Design:
      a. Shade structure canopy design shall be completed and constructed by the shade structure manufacturer.
      b. Shade structure canopy design, as it relates to connecting to the existing building, shall be coordinated with the Engineer of Record.
   2. Concrete Foundation Design:
      a. Concrete foundation design shall be completed by the shade structure manufacturer and constructed by the general contractor.
   3. Anchor bolts for the shade structure foundations shall be hot dip galvanized and supplied by the shade structure manufacturer.
   4. The shade structure structural steel supports shall be installed by the shade structure manufacturer under the direct supervision of the manufacturer's representative.
   5. Design Submittal: The Contractor shall submit three sets of detailed design calculations and final plans, elevations, and details of the shade structure(s). All calculations and drawings shall be prepared and sealed by a professional Structural Engineer (P.E.) –experienced in shade structure design and licensed in the state where the structure is to be built.

D. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.
   3. See Sections 01 33 00 and 01 60 00.

E. Operation and Maintenance Data: Submit O&M manuals according to the requirements of Section 01 92 00 - Facility Operation and Maintenance. For the following to include in emergency, operation, and maintenance manuals:
   1. Assembly.
   2. Polyester powder coat finishes.

F. Warranty: Sample of special warranty.

1.06 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Codes and Standards:
   1. In addition to complying with all applicable codes and regulations, comply with pertinent recommendations contained in the following:
      a. "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings" of the American Institute of Steel Construction.

C. Manufacturer's Qualifications: Company specializing in manufacturing products specified in this section with not less than three (3) years of documented experience.

D. Installer Qualifications: Company specializing in performing the work of this Section with a minimum of three (3) years of experience.

E. Products Requiring Electrical Connection: Listed and classified by UL as suitable for the purpose specified and indicated.

1.07 DELIVERY, STORAGE & HANDLING

A. Acceptance at Site: Ensure materials arrive at the site in unopened and undamaged containers.

B. Storage: Keep material from freezing, store on pallets in a cool place.

C. Deliver outdoor shade structure cardboard-wrapped or crated to provide protection during transit and job storage.

D. Inspect outdoor shade structure on delivery for damage. Minor damages may be repaired provided refinished items match new work and are acceptable to the Architect; otherwise, remove and replace damaged items as directed.

1.08 WARRANTY

A. All work of this Section shall be warranted against all defects of material and/or application for a period of one (1) year from the date of acceptance. The shade structure's fabric top material shall be warranted for six (6) years against failure from significant deterioration. Any failures that may occur within this warranty period, due to defective installation and/or materials, shall up written notification of such failure be immediately repaired or replaced.

1.09 PROJECT CONDITIONS

A. Field Measurements: Verify layout information for shade structure as shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
   1. USA Shade and Fabric Structures.

2.02 TYPES

A. "Awning" Shade Structure.
   1. Shade Fabric Top Material:
      a. Raw Material: High-density fire-retardant polyethylene with ultra-violet additives.
      b. Construction: Monofilament and tape construction giving a stable material to ensure material will not unravel if cut.
      c. Sewing Specifications:
         1) Strengthened with 16 oz. Non-tear vinyl material.
         2) Protective Webbing: Sewn into all areas where steel cable enters/exits cloth pockets.
   2. Tension Cable & Related Hardware:
      a. General: All hardware to be first grade stainless steel. All bolt fittings include nylon washers for watertight seals at all joints.
      b. Bolts: All erection bolts are ASTM A307, Grade B, treated to retard corrosion, or stainless steel.
      c. Wire Rope: ¼" nominal diameter, 7 strand, 19 wires per strand (minimum), with a minimum nominal tensile strength of 9,000 pounds. Wire rope shall be secured with approved fittings and cable hardware, as per manufacturer's specifications.
   3. Structural Steel Support System:
      a. Where size of structure or determined loads requires larger structural steel members or steel greater than 7-gauge thickness, carbon steel may be substituted. Cleaning and coating of carbon steel conforms to the following:
         1) A de-greasing agent is applied to remove surface oil and grease.
         2) An acid-phosphate wash is applied to etch and prepare the surface for powder-coating, where wall thickness requires preheating.
         3) Steel members are preheated prior to powder coat application to assure adhesion.
      b. All carbon Structural Steel shall be ASTM A36, except steel pipe columns, which shall be ASTM A53, Grade B, unless otherwise noted. Slip fittings are manufactured using drawn-over-mandrel steel with minimum yield strength of70 ksi and a minimum tensile strength of 80 ksi.
      c. Steel telescoped sleeves do not have more than 1/16" tolerance, with no less than 4" overlap at all sleeves. All internal fittings are welded on one side.
      d. Structural steel is detailed, fabricated, and erected in accordance with AISC specifications.
      e. Shop connections are welded unless noted otherwise. Field connections are separately indicated on the shop drawings.
      f. All welds are performed using E70 electrodes or gas-metal arc welding using ER 7053 wire. All fillet welds are a minimum 3/16" unless otherwise noted. All steel shall be welded shut at terminations to prevent internal leakage.

g. All structural steel plates are rust/corrosion treated by zinc electroplating. Steel tubing and plates are finished with a minimum of 2.5 to 3.5 mil thick UV-inhibited weather resistant powder coat.

B. Accessories to outdoor shade structures:
   1. Ceiling fans.
   2. See Electrical drawings and Specifications.
      a. See Architectural drawings for size and location.
      b. Coordinate mounting, wiring and controls with Shade Structure provider and electrical.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for shade structures before installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 FABRICATION

A. Fabricate all shade structures in strict accordance with the approved Shop Drawings and referenced standards.

3.03 INSTALLATION OF FOOTINGS & FOUNDATIONS

A. Foundations shall be installed in strict accordance with the Shop Drawings. All supplies, labor and installation will be furnished by others and not the responsibility of the shade structure manufacturer. Install in accordance with the manufacturer's structural drawings and instructions.

B. If AHJ requires Special Inspections of footings, coordinate special inspections with owner and Spec Section 01 45 33.

3.04 ERECTION

A. Erect all shade structures in strict accordance with the shop drawings and all pertinent regulations and standards.

3.05 CLEAN-UP

A. Upon completion of the work of this section, immediately remove all debris and rubbish occasioned by this work.

3.06 OWNER INSTRUCTION

A. Manufacturer shall train Life Time personnel in the operation, maintenance, required removal, etc., of the shade structures at the job site during start-up.

END OF SECTION

SECTION 32 84 00
PLANTING IRRIGATION

PART 1 GENERAL

1.01 SUMMARY

A. Scope of work: Furnish and install the complete underground irrigation system specified herein including: enclosure, meter, backflow prevention and Irrigation controller throughout site; including labor, materials, equipment, apparatus, and services for the testing, adjusting, retesting and readjusting as required to place the system in an approved operating condition.

B. Unless otherwise specified, the plans and specifications are intended to include everything obviously requisite and necessary for the proper installation and completion of the work whether each necessary item is mentioned herein or not.

C. The plans and specifications are intended to be cooperative and any item called for in one and not the other shall be as binding as if called for in both.

D. Any Contractor field alterations to the plan, details, or specifications will not be approved by the Facility Manager and/or Landscape Architect. Submittals for substitutions must be submitted 14 days prior to bid for consideration.
   1. The irrigation systems shall include the following:
      a. Source Location – from 4” water line (By Others), meter, backflow (meter and backflow to be installed on “flange” fitting for ease of removal). Contractor to verify location (approximate locations shown in design documents), quality and available flow characteristics as listed in design documents. Contractor to inform Facility Manager’s Representative of any perceived issues with source location.
      b. Control System:
         1) As approved by LT Operations.
         2) Cellular Modem - to be installed by a qualified Contractor.
         3) Soil Moisture Sensors
         4) Flow Sensor
         5) Pressure Sensor Kit
         6) Lightning Arrestor, with grounding as required.
      c. Piping.
      d. Sprinkler heads.
      e. Valves and Valve boxes.
      f. Control wiring & Grounding.
      g. Fittings.
      h. Electrical connections.
      i. Quick-couplers.
      j. All other necessary accessories.
      k. System Manuals.
      l. Instructional walk-through with Facility Manager.

E. Limits of work: Area within project limits as delineated on the irrigation plan.

F. Related Sections: The following Sections contain requirements that relate to this Section:
   1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 DEFINITIONS

A. Backfill: The earth used to replace or the act of replacing earth in an excavation.
   1. Balled and Burlapped Stock: Plants dug with firm, natural balls of earth in which they were grown, with ball size not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required; wrapped with burlap, tied, rigidly supported, and drum laced with twine with the root flare visible at the surface of the ball as recommended by ANSI Z60.1.

B. Balled and Potted Stock: Plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required.

C. Bare-Root Stock: Plants with a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not less than minimum root spread according to ANSI Z60.1 for type and size of plant required.

D. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of plant required.

E. Duff Layer: The surface layer of native topsoil that is composed of mostly decayed leaves, twigs, and detritus.

F. Fabric Bag-Grown Stock: Healthy, vigorous, well-rooted plants established and grown in-ground in a porous fabric bag with well-established root system reaching sides of fabric bag. Fabric bag size is not less than diameter, depth, and volume required by ANSI Z60.1 for type and size of plant.
   1. Finish Grade: Elevation of finished surface of planting soil.

G. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.
   1. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

H. Pests: Living organisms that occur where they are not desired, or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), mammals (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

I. Planting Area: Areas to be planted.

J. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

K. Plant, Plants, Plant Material: These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.
   1. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.

L. Stem Girdling Roots: Roots that encircle the stems (trunks) of trees below the soil surface.

M. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.
   1. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

N. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.

1.03 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Irrigation contractor must be able to provide “Verifiable Documentation” that they have the technical qualifications, experience, trained personnel and facilities to perform the specified work, including experience with Irrigation control system to be installed and have been engaged in sprinkler design and installation, of systems of similar size and scope for a minimum of five years. Contractor must

submit, along with bid, a list of five projects/contacts of similar scope completed within the last three years.

C. Quality Control Criteria:
   1. Provide irrigation products as described in this specification and according to manufacturer's specifications.
   2. Contractor shall have, on site at all times during construction, a designated individual who is qualified by the irrigation system manufacturer. No work shall be done on site when the authorized individual is not on site.
   3. Comply with requirements of the State of installation for prevention of backflow and back-siphonage.
   4. Comply with requirements of the State of installation for plumbing and other regulations affecting site irrigation.
   5. Comply with National Plumbing Code, National Electric Code, and all other applicable city or state codes.

1.04 SUBMITTALS

A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.

B. Submit manufacturer's literature, technical data, and recommendations for the system as specified including:
   a. Certificate from Irrigation System Manufacturer that Installer is qualified to install the system.
   b. Pipe.
   c. Fittings.
   d. Valves.
   e. Controller/Flow Sensor.
   f. Backflow preventer.
   g. Wiring & Grounding.
   h. Valve boxes.

C. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.
   3. See Sections 01 33 00 and 01 60 00.

D. Closeout Submittals – Submit the following:
   1. As-built drawings: Following construction of system, submit two (2) reproducible hard line sets of as-built drawings and an electronic copy (BIM or AutoCAD release 2018 or newer).
   2. Irrigation controller complete setup including but not limited to;
      a. Programs for turf, landscape and annuals.
      b. Flows learned and verified for each zone.
      c. Moisture Sensors setup and verified.
      d. Pressure Sensor setup and verified.
      e. Zone Information including – type, decoder information and location descriptions.
      f. Grounding/Lightening Arrestors locations and field readings at all locations.

E. Submit color-coded As-Built drawing of controller chart including zone descriptions, locations, decoder serial numbers and suggested run times.

1.05 JOB CONDITIONS

A. Contractor shall carefully examine the work site, local conditions, specifications and plot plan for any existing conditions and limitations that may apply to the work. Submission of a proposal shall be considered evidence than an examination has been conducted and that any questions and/or concerns have been satisfied.

B. Utilities: Determine location of utilities and perform work in a manner which will avoid possible damage. When necessary the Contractor shall make any minor adjustments in location or alignment of the new work. Hand excavate, as required. Maintain grade stakes set by others until removal is mutually agreed upon by parties concerned. Contact Facility Manager if potential conflicts are apparent.

1.06 SEQUENCING AND SCHEDULING

A. Schedule and coordinate to facilitate the most expeditious completion of the project in a workmanlike manner.

B. Consult all other relevant specification sections to determine the extent of work specified elsewhere but related to that included herein.

C. Schedule and coordinate all required irrigation utility connections with other project trades and/or utility companies.

D. Obtain information pertaining to location of all proposed lines and accessories prior to irrigation installation.

E. Contractor shall assume responsibility for locating all site utilities and perform work in a manner to avoid damage.

1.07 PROTECTION OF EXISTING CONDITIONS

A. Any existing structures, equipment, utilities, pavement, landscaping, etc., damaged by Contractor during the course of the work including any subsequent damage caused by leakage or settling of piping shall be restored at Contractor's expense.

1.08 HANDLING

A. Deliver irrigation system components in manufacturer’s original undamaged and unopened containers with labels intact and legible.

B. Deliver plastic piping in bundles, packed to provide adequate protection of pipe ends, both threaded and plain. Pipe and accessories shall be handled in such manner as to ensure delivery to the trench in sound, undamaged condition. Before installation, the pipe shall be inspected for defects. The interior of pipe and accessories shall be thoroughly cleaned of foreign matter before being lowered into the trench and shall be kept clean during laying operations by plugging or other approved method.

C. Store and handle materials to prevent damage and deterioration.

D. Provide secure, locked storage for valves, sprinkler heads, and similar components that cannot be immediately replaced to prevent installation delays.

E. Manufacturer’s Specifications: The latest printed specifications of approved manufacturer of materials shall become part of these specifications.

1.09 EXTRA MATERIALS

A. Provide extra materials as follows:
   1. Six extra sprinkler heads of each type and size.
   2. Two valve keys for manual valves.
   3. Two Quick-Coupler Keys with hose swivels.
   4. Six wrenches for each type head core and removing and installing each type head.

PART 2 PRODUCTS

2.01 MAIN LINE

A. Piping on pressure side of irrigation control valves:
   1. Polyvinyl chloride (PVC) 1120-1220, SDR 21 Class 200, and conform to ASTM standards D2241-05 & D2672 or latest revision. Materials shall conform to all requirements of D1784, or latest revision.
   2. Main line size 4” and above shall be gasket type pipe & fittings. Gasket fittings can be either ductile iron or PVC gasket fittings with joint restraints.

2.02 LATERALS

A. Piping on non-pressure side of irrigation control valves:
   1. Polyvinyl chloride (PVC) 1120-1220, SDR 26 Class 160, and conform to ASTM standards D2241-05 & D2672 or latest revision. Materials shall conform to all requirements of D1784, or latest revision.
   2. Pipe 1-1/4" and smaller pipe may also be flexible non-toxic polyethylene pipe made for 100% virgin material meeting N.S.F. (National Sanitation Foundation) standard #14 for use in pressure potable water applications, for 800 design stress. All sizes shall have a minimum 100 P.S.I. working pressure rating. All polyethylene pipes shall be continuously and permanently marked with the manufacturer's name, material, size, and schedule. Pipe shall conform to A.S.T.M., D2239, and D1248 (3C5PE34) or latest revision.

2.03 FITTINGS

A. Solvent welded socket fittings conforming to ASTM D2467 (Schedule 80 PVC) and ASTM D2466 (Schedule 40 PVC). Threaded type fittings shall conform to ASTM D2464 (Schedule 80 PVC). Solvent cement shall conform to ASTM D2564. Swing Joints for all rotary/gear driven sprinkler heads shall be minimum schedule 40, as manufactured by Dura or approved equal. Burst strength of fittings shall equal or exceed that of the pipe on which they are installed.

2.04 SPRINKLER HEADS

A. Sprinkler heads shall be installed as shown in design documents.

B. Gear Driven Rotary Heads: Hunter I-20, nozzle and arc as shown on design documents. Sprinkler case shall be of heavy-duty plastic construction rubber cover, Water lubricated gear drive, extra strong spring and Drain check valve for up to 10’ of elevation change. Match the precipitation rates between full circle and part circle heads when valved together in the same zone.

C. Pop-Up Spray Heads: Hunter PRS30-04-CV & MP-PRS40-04-CV in Turf & Hunter PRS30- 12-CV, MP-PRS40-12-CV in Plantings. Matched Precipitation Nozzles - arcs as shown on design documents. Sprinkler case shall be of heavy-duty plastic construction with plastic or rubber cover, extra strong spring. Match the precipitation rates between full circle and part circle heads when valved together in the same zone. Nozzles shall be interchangeable.

D. Adjustable nozzles are acceptable only in “odd” angle applications.

2.05 CONTROL VALVES

A. Remote control valves shall be Hunter ICV Series. Valves shall have Heavy-duty solenoid, High grade construction, and Manual bleed, Flow control with non-rising handle, rigid diaphragm support, Single piece diaphragm, Globe and angle configurations, Captive bonnet bolts and solenoid plunger.

2.06 CONTROLLER

A. Control system: Provide control system with the following features, compliant with local water-use regulation, and acceptable to LT Operations.
   1. Controller shall have an outdoor painted aluminum or stainless steel wall mount controller.
   2. Cell Modem.
   3. Water Management Functions:
      a. Moisture Sensors – located in design documents.
      b. Pressure Sensor – located in design documents.
      c. Rain Sensors--located in design documents.
      d. On-Site Rain/Freeze Switch.

B. Mount the controller in such a way as to simplify the programming/visibility of the controller (see detail). Contractor to ensure controllers and wire path are grounded to 10 OHM or less. Verify the exact location with the Facility Manager and/or Landscape Architect while still adhering to the manufacturer’s recommendations.

2.07 QUICK-COUPLING VALVES

A. Provide quick coupling valves as shown in design documents.

B. Provide six (6) valve keys fitted with 3/4" swivel hose cells.

C. Quick Coupling Equipment:
   1. Valves: One-piece body constructed from heavy-duty cast bronze with a 1" FIP riser connection.
   2. Quick Couplers: Single lug coupler of heavy cast bronze and detachable handle.
   3. Swivel Hose ELL: Heavy cast bronze, connected to quick couplers for hose connection.
      a. 1" FIPX 1" Male Hose Threads.
      b. Or approved equal.
   4. Each quick coupler should be installed in a valve box by Carson (or approved equal) and packed with pea gravel, 4" in depth.

2.08 VALVE BOXES

A. Provide box and cover, with open bottom and openings for piping; designed for installing flush with grade. Include size as required for valves and service. The box shall be of plastic construction with UV protection. Boxes shall be vandal resistant including lockable lid. Permanently label valve box cover with zone number. Box and lid assembly color shall be green color.

B. All valves shall be installed in 12” rectangular valve box – 1 valve per valve box.

C. All drip valve assemblies shall be contained in 12” minimum rectangular box, one valve per valve box.

D. Accepted manufacturers: Carson.

E. Decoders shall be secured to lip of valve box.

F. All valve boxes shall be permanently labeled with brass/stainless tag indicating zone number and/or equipment enclosed.

2.09 CONTROL WIRE

A. Electrical control wires shall be a jacketed, minimum of #14 gauge wire - #12 gauge on any run over 2000 feet. Run an additional two-wire path consisting of a jacketed and twisted pair of #14 gauge wire, as manufactured by Paige. Two-wire path shall be stubbed in to all valves in the system.

B. Provide separate wire path, different color, for each controller.

C. The wire path shall be grounded, to 10 ohm or less, and at a maximum of 500 foot intervals. Grounding shall also be installed on the end of all cable runs.

D. Future wire jackets, if specified, shall be a different color than initial “field” wires.

E. Provide a minimum of 3’ loop for ease of connection at valves and six to ten feet extra at controller location.

2.10 BACKFLOW PREVENTER

A. Provide Vacuum Breaker only if allowed by code and local ordinance.

B. Product:
   1. Febco Vacuum Breaker or Febco RPZ.
   2. Or approved equal.

C. Backflow preventer shall be contained in separate enclosure.

2.11 RAIN/FREEZE SENSOR

A. Sensor shall be capable of rain/freeze shut off. The device shall be mounted in a location unobstructed by walls, trees, or other hindrances (as not to be vandalized). Coordinate final field placement with Facility Manager’s Representative.

2.12 MANUAL VALVES

A. Manual valves shall be bronze gate type. Manual valves shall be sized according to the line size they are being installed on.

B. Manual valve location(s) - refer to plan.

C. Manual valves shall be “push-on” type with joint restraints 3” and larger.

2.13 REMOTE CONTROL

A. Provide remote control and monitoring of the irrigation system. Contractor to verify operation over the entire site and make any adjustments necessary to ensure uninterrupted coverage of site.

2.14 DRIP IRRIGATION

A. Drip pipe and all components are to be specifically manufactured for underground drip irrigation by Rain Bird.

B. Drip control valves shall have basket type, pressure regulating filter assembly, with visible gauge on top of basket.

C. System is to be self-cleaning, pressure compensating and UV resistant. Drip line shall be buried a minimum of 4” and a maximum of 6” deep in planting soil. Staple drip lines a minimum of every four feet and at every change in direction.

D. All “headers” for drip line shall be PVC – minimum 1” or manufactured header pipe such as Rain Bird QF Dripline Header.

E. At least one shut-off valve, flush valve, operation indicator to be installed in each drip irrigation bed.

F. Drip valve assemblies shall be placed in a 12” rectangular valve box – one valve per valve box.

PART 3 EXECUTION

3.01 PERMITS, LICENSES AND CERTIFICATES

A. The Contractor shall procure all permits and licenses, except as otherwise indicated, pay all charges and fees and give all notices necessary and incident to the proper and lawful prosecution of the work.

B. He shall also obtain and supply the Facility Manager all certificates required to show that the work has been performed in accordance with the building, plumbing, other authorities, the Board of Fire Underwriter's, or such other like bodies, as the specifications may require directly or by implication.

C. When the work performed affects the property of facilities of public utility or other corporations or of private persons, he shall obtain and supply from such corporations or person if required, statements that the work has been performed satisfactorily so far as their interests are affected and that all claims therefore have been settled by the Contractor.

3.02 RIGHTS OF WAY

A. The Contractor shall acquire the necessary right of way or lawful authority that may be necessary for approved crossings or occupation of any roads, street or alleys upon which the contract work will be done.

3.03 UNDERGROUND STRUCTURE

A. The Contractor shall be responsible for all necessary information regarding the exact location of existing underground structures and utilities and shall mark their location, at the site.

B. The Contractor shall be liable for the damages to and the cost of repairing or replacing any buried conduit, cables or piping encountered during the installation of the work, unless they were not marked or the Contractor was not previously informed of such underground utilities. If the Contractor is aware of such utilities, he shall immediately have the incurred damages repaired at his own expense. Conversely, the Facility Manager shall be liable for the cost of repairing to any of those existing utilities of which the Contractor had not been previously informed.

3.04 EXCAVATING AND TRENCHING

A. Perform excavations as required for installation of work. Restore all surfaces, existing underground installations, etc., damaged or cut as a result of the excavations, to their original condition.

B. Dig trenches wide enough to allow a minimum 6" between parallel pipelines. Trench sufficient depth to provide minimum cover (18” for all main lines and 12” for all laterals) as measured from finish grade as shown on drawings.

3.05 SLEEVING

A. Install PVC, see plan for type, sleeves where any control wire and/or pipe pass through or under walls.

B. Install PVC, see plan for type, sleeves for control wiring and pipe under walks and paving.

C. Main line shall be placed in PVC, see plan for type, sleeving that is a minimum of two sizes larger than pipe contained. Lateral line sleeving shall be a minimum of two pipe sizes larger than pipe contained.

D. Sleeves to be provided and extend a minimum of 12" beyond edges of walls, walks, and paving.

E. Mark the sleeve ends with an iron post.

F. Place wires in separate sleeve (1 ½" minimum).

G. Coordinate sleeve installation with other trades as required.

3.06 PIPE INSTALLATION

A. Install pipe in accordance with manufacturer's instructions.
   1. Solvent-weld PVC pipe and fittings, using primer, solvents, and methods recommended by manufacturer, except where screw connections are required. Clean pipe and fittings of dirt and moisture before assembly. Snake pipe from side to side of trench bottom to allow for expansion and contraction. Make all connections between PVC pipe and metal valves or pipe with threaded fittings using PVC male adapters.
   2. Use Teflon tape only on threaded joints, plastic to plastic and/or plastic to metal. Assemble threaded PVC fittings finger-tight plus one to two turns - no more.

B. Install thrust blocks on main lines (larger than 3") at locations that make a change of direction.

C. Avoid following piping layout situations:
   1. Avoid piping layout along sides of structures.
   2. Avoid odd angles in piping layout.
   3. Avoid unbalanced friction losses.
   4. Avoid high friction losses.
   5. Avoid excessive trenching.

3.07 SPRINKLER HEADS

A. Location of Sprinkler Heads: Sprinkler heads adjacent to back-of-curbs shall be located 6" off of curb edge and ½" below top of cub to prevent damage to head. Contractor is responsible for 100% radius (head-to-head) overlap coverage. When possible, locate sprinkler heads so that trees are approximately halfway between heads. Sprinkler heads and quick coupling valves shall be installed perpendicular to grade and level with terrain, unless otherwise indicated. Do not spray buildings or sidewalks.

B. All risers to heads shall be constructed to permit height adjustment of head.

C. Adjustable nozzles are acceptable only in "odd angle" situations. Fixed arc nozzles are required on all other heads.

3.08 ZONE VALVES

A. Remote Control Valves: Install control valves in valve boxes where shown and group together where practical. Place no closer than 12" to walk edges, buildings, and walls. Set valve boxes flush with finish grade.

B. Male adapters are NOT permissible – Utilize toe nipples when installing valves or equipment with threaded fittings.

C. Drip valve assemblies shall be placed in a 12" rectangular valve box – one valve per valve box.

3.09 CONTROLLERS

A. Install per local code and manufacturer's instructions.

B. Connect remote control valves to controller in clockwise sequence to correspond with station setting beginning with Stations 1, 2, 3, etc.

C. Affix a non-fading copy of irrigation diagram to cabinet door. Irrigation diagram is to be sealed between two sheets of 20mm laminate. Irrigation diagram shall be a copy of the as-built drawing and shall show clearly all valves operated by the controller, showing station number, valve size, and type of turf/planting irrigated.

D. Exact field location of controllers to be verified before installation. Coordinate the electrical service to these locations.

3.10 CONTROL WIRING

A. Install control wires with sprinkler mains and laterals in common trenches wherever possible. Lie to the side of pipeline and tie wires in bundles at 10' intervals and allow slack for contraction between ties.

B. Provide a minimum of 3' of looped extra ground and control wire at each valve and at 200' intervals on long wire runs. Snake wires in trench to allow for contraction of wires.

C. Control wire splices at remote control valves to be sealed with a Direct Burial Splice Kit - 3M DBY-6/DBR-6. Ensure that splice sealant completely blocks path to wire nut inside of spice.

3.11 VALVE BOXES

A. All valve boxes shall be supported in the ground by using paver style bricks in every corner or side.

B. See valve box detail on plan for installation directions.

C. Provide sufficient clearance (minimum 4”) between valve box cover and the automatic valve, to prevent damage if the valve box is driven over.

D. Wood supports of any kind are not allowed.

E. All valve boxes shall be permanently labeled with brass/stainless tag indicating zone number and/or equipment enclosed.

3.12 IMPROPERLY OPERATING OR LOCATED EQUIPMENT

A. Any equipment which fails to operate properly and/or is located incorrectly shall be promptly corrected or relocated at the Contractor's expense. If the Contractor wishes to make any field changes, he must receive written permission from both the Facility Manager and Landscape Architect.

3.13 THRUST BLOCKS

A. Provide thrust blocks at all changes in size or direction of mainline piping (3” and larger unless otherwise specified). Elbows, reducers, plugs, and the opposite side of tee branches all require thrust blocks. Concrete thrust blocks are constructed by pouring concrete between the fitting and the undisturbed bearing wall of the trench.

3.14 FLUSHING AND TESTING

A. Cap or plug all openings as soon as lines have been installed to prevent entrance of materials that would obstruct the pipe. Leave in place until removal is necessary for completion of installation.

B. Thoroughly flush out all water lines before installing heads, valves, and other hydrants.

C. Testing: All instruments, equipment, facilities, and labor required to conduct the tests shall be provided by Contractor. Piping shall be tested hydrostatically before backfilling and proved tight at a hydrostatic pressure of 100 psi without pumping for a period of one hour with an allowable pressure drop of 5 psi. If hydrostatic pressure cannot be held, Contractor shall make adjustments or replacements and the tests repeated until satisfactory results are achieved and accepted by the Facility Manager.

D. Upon satisfactory completion of testing, complete assembly and adjust all heads for proper arc and radius.

3.15 BACKFILL AND COMPACTING

A. After system is operating and required tests and inspections have been made, backfill excavations and trenches with clean soil, free of rubbish.

B. Backfill for all trenches, regardless of the type of pipe covered, shall be compacted to minimum 95% density under pavements, 85% under planted areas.

C. Compact trenches in areas to be planted by thoroughly flooding the backfill. Jetting process may be used in those areas.

D. Dress off all areas to finish grade.

3.16 CLEANUP

A. Keep areas of work clean, neat, and orderly at all times. Keep paved areas clean during installation. Clean up and remove debris from the entire work areas prior to final acceptance.

B. Protect irrigation system and materials from damage due to performance of work, operations by other contractors, trades and trespassers. Maintain protection during installation and testing period.

C. The Contractor shall be responsible for all damage caused by his operations to trees, turf, shrubs, curbs, paving, structures, utilities, etc., on the site or adjacent to the site of the work and shall repair, replace or otherwise make good any damage caused by their work.

3.17 WINTERIZATION AND SPRING START-UP OF IRRIGATION SYSTEM

A. The contractor shall prepare the entire irrigation system for one winter by removing all water within the mainline and lateral piping. Water shall be diverted so as not erode existing landscaping or final grades. If damage does occur, the contractor shall make repairs to the Facility Manager’s satisfaction at no additional cost.

B. The contractor shall provide one Spring Start-up of the entire irrigation system by filling the mainline and lateral piping with water and operate all control valves with the automatic controller. The contractor shall also set the controller timing for spring irrigation.

C. During Wintering and Spring Start-up the contractor shall contact the Facility Manager and current landscape maintenance provider responsible for the project site and educate them to the operations of the system. Also, the contractor shall provide a written copy to the Facility Manager of the irrigation timing required for establishing plants during late spring, summer and fall schedules.

D. The contractor shall coordinate and assemble a written instruction manual that indicates step by step the winterizing and start-up operations. The instructions shall be included in the O & M manuals.

PART 4 ACCEPTANCE

4.01 ACCEPTANCE

A. Demonstrate operation of all irrigation zones for the Facility Manager and/or Landscape Architect, a current As-Built is to be provided to the Facility Manager/Landscape Architect for purposes of the walk-thru. All irrigated areas are to have 100% coverage. Contractor shall add additional heads, as necessary, at no cost to the Facility Manager. Adjust all heads as required for proper operation, alignment, elevation, radius, and arc.

B. A field training course shall be provided for designated operating and maintenance staff members. Training shall be provided for a total period of up to 16 hours of normal working time and shall start after the central control system, weather station and field components of the irrigation system are functionally complete and major adjustments to controller, due to establishment of materials, is substantially complete. Field training shall cover all the items contained in the operating and maintenance manuals.

C. The Contractor will provide on-site consultation with the Facility Manager's operating personnel for a period of 6 months, not to exceed 8 hours per month, at no cost to the Facility Manager. This consultation will be provided at the Facility Manager's request.

D. All future visits required by the Irrigation Landscape Architect, after initial punch list, will be charged to the irrigation contractor.

4.02 GUARANTEE

A. The entire sprinkler system will be unconditionally guaranteed against defects in material and workmanship, including settling of backfilled areas below grade and adjusting heads to proper level for a period of one year from date of acceptance.

B. In addition to minor adjustments, any defective electrical controls, valves, sprinkler heads or other working parts will be repaired or replaced without cost to the Facility Manager for a period of one year from date of acceptance.

C. Contractor to provide one winterization and spring start up of irrigation system.

D. Damage by others during the one-year guarantee period will be the Facility Manager's responsibility.

4.03 RECORD INFORMATION

A. Furnish record drawings of the complete irrigation system.

B. Record Drawings and Controller Chart:
   1. Provide a complete set of up-to-date as built drawings, and an electronic copy (BIM or AutoCAD release 2018 or newer).
   2. Prepare a controller chart showing:
      a. Location of all sections, valves, lateral lines, and routes of control wires.
      b. Identify all valves as to size, station, number, and type of irrigation.
      c. Provide chart as a black-line print with a different color used to show area of coverage for each station.
      d. Locate chart inside controller door. Seal chart between two pieces of plastic.
      e. Provide suggested irrigation schedule at time of acceptance.
      f. Complete chart and receive approval prior to final inspection of irrigation system.

PART 5 IRRIGATION MANAGEMENT DURING ESTABLISHMENT PERIOD

5.01 ESTABLISHMENT PERIOD

A. Plant Establishment Period (PEP) begins on the date that initial planting operations (Substantial Completion) on the project are completed and continues until final acceptance of the project, and will last for the following period:
   1. 90 Days.
   2. 2 growing seasons. (as defined by Landscape Architect for project location)
   3. 2 calendar years.

5.02 ESTABLISHMENT WORK

A. Keep irrigation operational in accordance with the Landscape Standards throughout the establishment period and submit Life Time Landscape Contractor Inspection Reports. Perform irrigation inspection work throughout the growing seasons and as necessary during the dormant seasons (as defined by Landscape Architect). The Landscape Architect may perform inspections throughout the PEP to verify compliance. The Landscape Architect will consider the Contractor non-compliant if the Contractor does not maintain the irrigation system throughout the PEP and does not submit Inspection reports.

5.03 ALL IRRIGATION

A. During the establishment period, perform the following:
   1. Inspect to assess the condition of the irrigation system and factors that may influence function and watering efficiencies. Inspect these conditions at least every two weeks during the growing season and at least every month during the dormant season;
   2. Submit a written Inspection report to the Landscape Architect via e-mail by the 1st and 15th of each month during the growing season and by the 1st of each month during the dormant season. The Landscape Architect will use the report-frequency and content to assess irrigation system compliance. The report may include scanned copies of the plan sheets with the Contractor notes, copies of the report form found in the Life Time Landscape Standards Manual. Include the following in the report:
      a. The project number.
      b. Engineer's name.

c. Name of Contractor's responsible scout or representative.
d. Dates work was performed.
e. Work locations.
f. Work completed.
g. Prevailing weather conditions.
h. Soil moisture assessments.
i. Insect, animal, vehicular, weather, or other damage.
j. System problems.
k. Modifications or recommendations.
l. Assessment of overall irrigation system.

3. Maintain soil moisture in accordance with the watering guidelines of the standard planting details shown on the plans.
4. Adjust irrigation controller to maintain the optimal balance of watering for the entire site and its plant material.
5. Repair, adjust, or replace broken, malfunctioning or inefficient components or parts in accordance with the irrigation design.
6. Provide and install replacement parts in accordance with Replacement Requirements and according to Construction Drawings and Specifications.
7. Prevent or repair damage that may lead to soil erosion and overwatering.
8. Perform irrigation operations consistent with irrigation practices detailed in the Life Time Landscape Standards.

5.04 REPLACEMENT REQUIREMENTS

A. Within the first half of the PEP, determine which irrigation components need replacing. Replace parts in accordance with initial installation requirements, including irrigation damage due to accidents, vandalism, theft, rodent damage, damage caused by the Contractor, or if ordered by the Landscape Architect, at no additional cost to the Owner. Conduct irrigation replacement operations as needed within the first half of the PEP. At least one week before irrigation replacement, submit a summary report of proposed irrigation replacements to the Landscape Architect. Include by attachment, copies of plan sheets with the proposed replacement parts and locations identified and a Life Time Certificate of Compliance for Irrigation, Irrigation Material, and Equipment, in the report. Using brightly colored paint, mark on site irrigation requiring replacement. Provide replacement irrigation parts and incidental materials that are equal to or better than the initial material required by the contract.

5.05 FINAL ACCEPTANCE

A. As a condition for terminating the PEP and conducting the final inspection, the Landscape Architect and Facility Manager may require the Contractor to bring the irrigation system work into compliance. At the end of the PEP, the Landscape Architect and Facility Manager along with the Establishment Contractor will perform a final inspection of the project.

5.06 TRANSITION TO LONG TERM MAINTENANCE

A. Upon final acceptance, the project will transition from Establishment Contractor maintenance of the irrigation system to Long Term Maintenance. A coordination meeting to transition from the Establishment Contractor to Long-Term Maintenance Contractor will take place one week prior to conclusion of the Establishment period to ensure all requirements are met and the Long-Term Contractor understands their role and when they will take over Maintenance.

END OF SECTION

SECTION 32 92 00
TURF AND GRASSES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Seeding.
   2. Sodding.
   3. Hydroseeding.
   4. Native grasses and wildflowers.
   5. No Mow grass.

1.02 RELATED SECTIONS:

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Section 01 33 00 - Submittal Procedures.

C. Section 01 40 00 - Quality Requirements.

D. Section 01 60 00 - Product Requirements.

E. Section 31 10 00 - Site Clearing: for topsoil stripping and stockpiling.

F. Section 31 23 00 - Excavation and Fill: for excavation, filling and backfilling, and rough grading.

G. Section 32 84 00 - Planting Irrigation: for turf irrigation.

H. Section 32 93 00 - Plants: for border edgings.

1.03 DEFINITIONS

A. Duff Layer: The surface layer of native topsoil that is composed of mostly decayed leaves, twigs, and detritus.

B. Finish Grade: Elevation of finished surface of planting soil.

C. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

D. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

E. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), mammals (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

F. Planting Soil: Standardized topsoil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

G. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or top surface of a fill or backfill before planting soil is placed.

H. Subsoil: All soil beneath the topsoil layer of the soil profile,and typified by the lack of organic matter and soil organisms.

I. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil, but in disturbed areas such as urban environments, the surface soil can be subsoil.

1.04 REFERENCE STANDARDS

A. AOSA RULES - Rules for Testing Seeds; 2024.

B. ASTM C602 - Standard Specification for Agricultural Liming Materials; 2023.

C. ASTM D5268 - Standard Specification for Topsoil Used for Landscaping and Construction Purposes; 2023.

D. TPI (SPEC) - Guideline Specifications to Turfgrass Sodding; 2006.

1.05 SUBMITTALS

A. Product Data: For each type of product indicated.
   1. Pesticides and Herbicides: Include product label and manufacturer's application instructions specific to this Project.

B. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.
   3. See Sections 01 33 00 and 01 60 00.

1.06 INFORMATIONAL SUBMITTALS

A. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.
   1. Certification of each seed mixture:
      a. Turfgrass sod.
      b. Native grass seed mix.
      c. No Mow seed Mix.
      d. Include identification of source and name and telephone number of supplier.

B. Qualification Data: For qualified landscape Installer.

C. Product Certificates: For soil amendments and fertilizers, from manufacturer.

D. Material Test Reports: For imported or manufactured topsoil per Section 31 23 00 - Excavation and Fill.

E. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of turf and seeded areas during a calendar year. Submit before expiration of required initial maintenance periods.

1.07 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Installer Qualifications: A qualified landscape Installer whose work has resulted in successful turf and native seeding meadow establishment.
   1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
   2. Experience Five years' experience in turf installation in addition to requirements in Section 01 40 00 - Quality Requirements.
   3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
   4. Personnel Certifications: Installer's field supervisor shall have certification from the Professional Landcare Network as a certified landscape technician – exterior with installation and maintenance specialty areas designated CLT-Exterior and one of the following:
      a. Certified Turfgrass Professional, designated CTP.
      b. Certified Turfgrass Professional of Cool Season Lawns, designated CTP-CSL.
   5. Pesticide Applicator: State licensed, commercial.

C. Soil-Testing Laboratory Qualifications: An independent laboratory or university laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.

D. Soil Analysis: **Will be by the local University or qualified testing facility** and available for each unamended soil type, furnish soil analysis and a written report by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; sodium absorption ratio; deleterious material; pH; and mineral and plant-nutrient content of the soil.
    a. Based on the test results, state recommendations for soil treatments and soil amendments to be incorporated. State recommendations in weight per 1000 sq. ft. (92.9 sq. m) or volume per cu. yd. (0.76 cu. m) for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.
    b. Report presence of problem salts, minerals, or heavy metals, including aluminum, arsenic, barium, cadmium, chromium, cobalt, lead, lithium, and vanadium. If such problem materials are present, provide additional recommendations for corrective action.

E. Preinstallation Conference: Conduct conference at Project site.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws, as applicable.

B. Sod: Harvest, deliver, store, and handle sod according to requirements in "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" in TPI (SPEC) "Guideline Specifications to Turfgrass Sodding." Deliver sod in time for planting within 24 hours of harvesting. Protect sod from breakage and drying.

C. Bulk Materials:
    1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
    2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
    3. Accompany each delivery of bulk fertilizers, lime, and soil amendments with appropriate certificates.

1.09 PROJECT CONDITIONS

A. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with initial maintenance periods to provide required maintenance from date of Substantial Completion.

B. Sod:
    1. Spring Planting: As specified on drawings.
    2. Fall Planting: As specified on drawings.

C. Native Seed:
    1. Spring Planting: As specified on drawings.
    2. Fall Planting: As specified on drawings.

D. No Mow Seed:
    1. Spring Planting: As specified on drawings.
    2. Fall Planting: As specified on drawings.

E. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

1.10 ESTABLISHMENT SERVICES

A. Initial Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in Part 4. Begin maintenance immediately after each area is planted and continue until acceptable turf is established but for not less than the following period:
    1. Sodded Turf:

a. 2 calendar years.

B. Initial Native Seed Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in Part 4. Begin maintenance immediately after each area is planted and continue until acceptable native seed is established, but for not less than the following period:
   1. 90 Days.
   2. 2 growing seasons. (as defined by Landscape Architect for project location)
   3. 2 calendar years.

C. Continuing Long Term Maintenance Proposal: May be requested from the Owner to have the Installer provide, in the form of a standard yearly (or other period) maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

PART 2 PRODUCTS

2.01 SEED

A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA RULES "Journal of Seed Technology; Rules for Testing Seeds" for purity and germination tolerances.

B. Seed Species: State-certified seed of grass species as follows:

C. Seed Species: Seed of grass species as follows, with not less than 95 percent germination, not less than 85 percent pure seed, and not more than 0.5 percent weed seed:
   1. Full Sun: Bermudagrass (Cynodon dactylon).
   2. Full Sun: Kentucky bluegrass (Poa pratensis), a minimum of three cultivars.
   3. Sun and Partial Shade: Proportioned by weight as follows:
      a. 50 percent Kentucky bluegrass (Poa pratensis).
      b. 30 percent chewings red fescue (Festuca rubra variety).
      c. 10 percent perennial ryegrass (Lolium perenne).
      d. 10 percent redtop (Agrostis alba).
   4. Shade: Proportioned by weight as follows:
      a. 50 percent chewings red fescue (Festuca rubra variety).
      b. 35 percent rough bluegrass (Poa trivialis).
      c. 15 percent redtop (Agrostis alba).

2.02 TURFGRASS SOD

A. Turfgrass Sod: Certified Number 1 Quality/Premium, including limitations on thatch, weeds, diseases, nematodes, and insects, complying with "Specifications for Turfgrass Sod Materials" in TPI's "Guideline Specifications to Turfgrass Sodding." Furnish viable sod of uniform density, color, and texture, strongly rooted, and capable of vigorous growth and development when planted.

B. Turfgrass Species: Bermudagrass (Cynodon dactylon), Carpetgrass (Axonopus affinis), Centipedegrass (Eremochloa ophiuroides), St. Augustinegrass (Stenotaphrum secundatum), Zoysiagrass (Zoysia japonica), Zoysiagrass (Zoysia matrella).

C. Turfgrass Species: Sod of grass species as follows, with not less than 95 percent germination, not less than 85 percent pure seed, and not more than 0.5 percent weed seed:
   1. Full Sun: Kentucky bluegrass (Poa pratensis), a minimum of three cultivars.
   2. Sun and Partial Shade: Proportioned by weight as follows:
      a. 50 percent Kentucky bluegrass (Poa pratensis).
      b. 30 percent chewings red fescue (Festuca rubra variety).
      c. 10 percent perennial ryegrass (Lolium perenne).
      d. 10 percent redtop (Agrostis alba).
   3. Shade: Proportioned by weight as follows:
      a. 50 percent chewings red fescue (Festuca rubra variety).
      b. 35 percent rough bluegrass (Poa trivialis).
      c. 15 percent redtop (Agrostis alba).

2.03 MEADOW GRASSES AND WILDFLOWERS

A. Wildflower Seed: Fresh, clean, and dry new seed, of mixed species as follows:
   1. As illustrated on the drawings.

B. Native Grass Seed: Fresh, clean, and dry new seed, of mixed species as follows:
   1. As illustrated on the drawings.

C. Wildflower and Native Grass Seed: Fresh, clean, and dry new seed, of mixed species as follows:
   1. As illustrated on the drawings.

2.04 INORGANIC SOIL AMENDMENTS

A. Lime: ASTM C602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent.

B. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.

C. Perlite: Horticultural perlite, soil amendment grade.

D. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through No. 50 sieve.

E. Sand: Clean, washed, natural or manufactured, and free of toxic materials.

F. Zeolites: Mineral clinoptilolite with at least 60 percent water absorption by weight.

2.05 ORGANIC SOIL AMENDMENTS

A. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 7.5; moisture content 35 to 55 percent by weight; 100 percent passing through 1-inch sieve; soluble salt content of 5 to 10 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:
   1. Organic Matter Content: 50 to 60 percent of dry weight.

B. Sphagnum Peat: Partially decomposed sphagnum peat moss, finely divided or of granular texture, with a pH range of 3.4 to 4.8.

2.06 FERTILIZERS

A. Bonemeal: Commercial, raw or steamed, finely ground; a minimum of 4 percent nitrogen and 20 percent phosphoric acid.

B. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.

C. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
   1. Composition: 1 lb/1000 sq. ft. of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
   2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

D. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
   1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
   2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

2.07 PLANTING SOILS

A. Planting Soil: ASTM D5268 topsoil, with pH range of 5.5 to 7, a minimum of 4 percent organic material content; free of stones 1 inch or larger in any dimension and other extraneous materials harmful to plant growth. Mix topsoil with the soil amendments and fertilizers as indicated in the testing reports.

B. Planting Soil: Existing, native surface topsoil formed under natural conditions with the duff layer retained during excavation process and stockpiled on-site. Verify suitability of native surface topsoil to produce viable planting soil. Clean soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.
   1. Supplement with another specified planting soil when quantities are insufficient.
   2. Mix existing, native surface topsoil with the following soil amendments and fertilizers as indicated in the soil testing reports.

C. Planting Soil: Imported topsoil or manufactured topsoil from off-site sources. Obtain topsoil displaced from naturally well-drained construction or mining sites where topsoil occurs at least 4 inches deep; do not obtain from agricultural land, bogs or marshes.
   1. Additional Properties of Imported Topsoil or Manufactured Topsoil: Screened and free of stones 1 inch or larger in any dimension; free of roots, plants, sod, clods, clay lumps, pockets of coarse sand, paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials harmful to plant growth; free of obnoxious weeds and invasive plants including quackgrass, Johnsongrass, poison ivy, nutsedge, nimblewill, Canada thistle, bindweed, bentgrass, wild garlic, ground ivy, perennial sorrel, and bromegrass; not infested with nematodes, grubs, other pests, pest eggs, or other undesirable organisms and disease-causing plant pathogens; friable and with sufficient structure to give good tilth and aeration. Continuous, air-filled, pore-space content on a volume/volume basis shall be at least 15 percent when moisture is present at field capacity. Soil shall have a field capacity of at least 15 percent on a dry weight basis.
   2. Mix imported topsoil or manufactured topsoil with the soil amendments and fetilizers to produce planting suitable soil as directed by the soil testing agencies.

D. Lightweight On-Structure Planting Soil: Soils provided by premanufactured blends suitable for on structure planting. See architectural drawings for specified soil composition and manufacturer.

2.08 MULCHES

A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.

B. Sphagnum Peat Mulch: Partially decomposed sphagnum peat moss, finely divided or of granular texture, and with a pH range of 3.4 to 4.8.

C. Fiber Mulch: Biodegradable, dyed-wood, cellulose-fiber mulch; nontoxic and free of plant-growth or germination inhibitors; with a maximum moisture content of 15 percent and a pH range of 4.5 to 6.5.

D. Nonasphaltic Tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application; nontoxic and free of plant-growth or germination inhibitors.

2.09 PESTICIDES

A. General: Pesticide, registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

B. Pre-Emergent Herbicide (Selective and Non-Selective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

C. Post-Emergent Herbicide (Selective and Non-Selective): Effective for controlling weed growth that has already germinated.

2.10 EROSION-CONTROL MATERIALS

A. Erosion-Control Blankets: Biodegradable wood excelsior, straw, or coconut-fiber mat enclosed in a photodegradable plastic mesh. Include manufacturer's recommended steel wire staples, 6 inches long.

B. Erosion-Control Fiber Mesh: Biodegradable burlap or spun-coir mesh, a minimum of 0.92 lb/sq. yd., with 50 to 65 percent open area. Include manufacturer's recommended steel wire staples, 6 inches long.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas to be planted for compliance with requirements and other conditions affecting performance.
   1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
   2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.
   3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
   4. Uniformly moisten excessively dry soil that is not workable and which is too dusty.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

3.02 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings from damage caused by planting operations.
   1. Protect adjacent and adjoining areas from hydroseeding and hydromulching overspray.
   2. Protect grade stakes set by others until directed to remove them.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.03 TURF AREA PREPARATION

A. Limit turf subgrade preparation to areas to be planted.

B. Newly Graded Subgrades: Loosen subgrade to a minimum depth of 6 inches. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
   1. Apply fertilizer directly to subgrade before loosening.
   2. Spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend planting soil.
      a. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.
      b. Mix lime with dry soil before mixing fertilizer.
   3. Spread planting soil to a depth of 6 inches but not less than required to meet finish grades after light rolling and natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.
      a. Spread approximately 1/2 the thickness of planting soil over loosened subgrade. Mix thoroughly into top 4 inches of subgrade. Spread remainder of planting soil.
      b. Reduce elevation of planting soil to allow for soil thickness of sod.

C. Unchanged Subgrades: If turf is to be planted in areas unaltered or undisturbed by excavating, grading, or surface-soil stripping operations, prepare surface soil as follows:
   1. Remove existing grass, vegetation, and turf. Do not mix into surface soil.
   2. Loosen surface soil to a depth of at least 6 inches. Apply soil amendments and fertilizers according to planting soil mix proportions and mix thoroughly into top 4 inches of soil. Till soil to a homogeneous mixture of fine texture.
      a. Apply fertilizer directly to surface soil before loosening.
   3. Remove stones larger than 1 inch in any dimension and sticks, roots, trash, and other extraneous matter.
   4. Legally dispose of waste material, including grass, vegetation, and turf, off Owner's property.

D. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1/2 inch of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit finish grading to areas that can be planted in the immediate future.

E. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

F. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.04 PREPARATION FOR EROSION-CONTROL MATERIALS

A. Prepare area as specified in "Turf Area Preparation" Article.

B. For erosion-control mats, install planting soil in two lifts, with second lift equal to thickness of erosion-control mats. Install erosion-control mat and fasten as recommended by material manufacturer.

C. Fill cells of erosion-control mat with planting soil and compact before planting.

D. For erosion-control blanket or mesh, install from top of slope, working downward, and as recommended by material manufacturer for site conditions. Fasten as recommended by material manufacturer.

E. Moisten prepared area before planting if surface is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

3.05 SEEDING

A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
   1. Do not use wet seed or seed that is moldy or otherwise damaged.
   2. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.

B. Sow seed at a total rate of 3 to 4 lb/1000 sq. ft.

C. Rake seed lightly into top 1/8 inch of soil, roll lightly, and water with fine spray.

D. Protect seeded areas with slopes exceeding 1:4 with erosion-control blankets and 1:6 with erosion-control fiber mesh installed and stapled according to manufacturer's written instructions.

E. Protect seeded areas with erosion-control mats where shown on Drawings; install and anchor according to manufacturer's written instructions.

F. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre to form a continuous blanket 1-1/2 inches in loose thickness over seeded areas. Spread by hand, blower, or other suitable equipment.
   1. Anchor straw mulch by crimping into soil with suitable mechanical equipment.
   2. Bond straw mulch by spraying with asphalt emulsion at a rate of 10 to 13 gal./1000 sq. ft. Take precautions to prevent damage or staining of structures or other plantings adjacent to mulched areas. Immediately clean damaged or stained areas.

G. Protect seeded areas from hot, dry weather or drying winds by applying compost mulch within 24 hours after completing seeding operations. Soak areas, scatter mulch uniformly to a thickness of 3/16 inch and roll surface smooth.

3.06 HYDROSEEDING

A. Hydroseeding: Mix specified seed, fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.

B. Native seed mixtures shall not be hydroseeded and hydromulched together. If necessary tackifiers can be applied by hydromulch, separately, following separate mechanical or hydroseedng as described above.

3.07 SODDING

A. Lay sod within 24 hours of harvesting. Do not lay sod if dormant or if ground is frozen or muddy.

B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to subgrade or sod during installation. Tamp and roll lightly to ensure contact with subgrade, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.
   1. Lay sod across angle of slopes exceeding 1:3.
   2. Anchor sod on slopes exceeding 1:6 with wood pegs or steel staples spaced as recommended by sod manufacturer but not less than 2 anchors per sod strip to prevent slippage.

C. Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches below sod.

3.08 TURF RENOVATION

A. Renovate existing turf.

B. Renovate existing turf damaged by Contractor's operations, such as storage of materials or equipment and movement of vehicles.
   1. Reestablish turf where settlement or washouts occur or where minor regrading is required.
   2. Install new planting soil as required.

C. Remove sod and vegetation from diseased or unsatisfactory turf areas; do not bury in soil.

D. Remove topsoil containing foreign materials such as oil drippings, fuel spills, stones, gravel, and other construction materials resulting from Contractor's operations, and replace with new planting soil.

E. Mow, dethatch, core aerate, and rake existing turf.

F. Remove weeds before seeding. Where weeds are extensive, apply selective herbicides as required. Do not use pre-emergence herbicides.

G. Remove waste and foreign materials, including weeds, soil cores, grass, vegetation, and turf, and legally dispose of them off Owner's property.

H. Till stripped, bare, and compacted areas thoroughly to a soil depth of 6 inches.

I. Apply soil amendments and initial fertilizers required for establishing new turf and mix thoroughly into top 4 inches of existing soil. Install new planting soil to fill low spots and meet finish grades.

J. Apply seed and protect with straw mulch as required for new turf.

K. Water newly planted areas and keep moist until new turf is established.

3.09 TURF MAINTENANCE

A. Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.
   1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
   2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
   3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.

B. Watering: Install and maintain temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf uniformly moist to a depth of 4 inches.
   1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.

2. Water turf with fine spray at a minimum rate of 1 inch per week unless rainfall precipitation is adequate.

C. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than 1/3 of grass height. Remove no more than 1/3 of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:
   1. Mow bentgrass to a height of 1/2 inch or less.
   2. Mow bermudagrass to a height of 1/2 to 1 inch.
   3. Mow carpetgrass, centipedegrass, perennial ryegrass, zoysiagrass to a height of 1 to 2 inches.
   4. Mow Kentucky bluegrass, buffalograss, annual ryegrass, chewings red fescue to a height of 1-1/2 to 2 inches.
   5. Mow bahiagrass, turf-type tall fescue, St. Augustinegrass to a height of 2 to 3 inches.

D. Turf Postfertilization: Apply fertilizer after initial mowing and when grass is dry.
   1. Use fertilizer that will provide actual nitrogen of at least 1 lb/1000 sq. ft. to turf area.

3.10 SATISFACTORY TURF

A. Turf installations shall meet the following criteria as determined by Architect:
   1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. and bare spots not exceeding 5 by 5 inches.
   2. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.
   3. Satisfactory Plugged Turf: At end of maintenance period, the required number of plugs has been established as well-rooted, viable patches of grass, and areas between plugs are free of weeds and other undesirable vegetation.
   4. Satisfactory Sprigged Turf: At end of maintenance period, the required number of sprigs has been established as well-rooted, viable plants, and areas between sprigs are free of weeds and other undesirable vegetation.

B. Use specified materials to reestablish turf that does not comply with requirements and continue maintenance until turf is satisfactory.

3.11 MEADOW

A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
   1. Do not use wet seed or seed that is moldy or otherwise damaged.

B. Sow seed at a total rate of 5 oz./1000 sq. ft.

C. Brush seed into top 1/16 inch of soil, roll lightly, and water with fine spray.

D. Protect seeded areas from hot, dry weather or drying winds by applying compost mulch within 24 hours after completing seeding operations. Soak areas, scatter mulch uniformly to a thickness of 3/16 inch and roll surface smooth.

E. Water newly planted areas and keep moist until meadow is established.

3.12 MEADOW MAINTENANCE

A. Maintain and establish meadow by watering, weeding, mowing, trimming, replanting, and performing other operations as required to establish a healthy, viable meadow. Roll, regrade, and replant bare or eroded areas and remulch. Provide materials and installation the same as those used in the original installation.
   1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and meadow damaged or lost in areas of subsidence.

2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
3. Apply treatments as required to keep meadow and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.

B. Watering: Install and maintain temporary piping, hoses, and meadow-watering equipment to convey water from sources and to keep meadow uniformly moist.
1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
2. Water meadow with fine spray at a minimum rate of 1/2 inch per week for six weeks after planting unless rainfall precipitation is adequate.

3.13 PESTICIDE APPLICATION

A. Apply pesticides and other chemical products and biological control agents in accordance with requirements of authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

B. Post-Emergent Herbicides (Selective and Non-Selective): Apply only as necessary to treat already-germinated weeds and in accordance with manufacturer's written recommendations.

3.14 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.

C. Remove nondegradable erosion-control measures after grass establishment period.

3.15 DISPOSAL

A. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.

3.16 DURATION OF MAINTENANCE

A. Maintenance of Turf and Grasses shall continue until Owner accepts that the processes listed above have been completed.

PART 4 TURF AND GRASS ESTABLISHMENT PERIOD

4.01 ESTABLISHMENT PERIOD

A. Plant Establishment Period (PEP) begins on the date that initial planting operations (Substantial Completion) on the project are completed and continues until final acceptance of the project, and will last for the following period:
1. 2 calendar years.

4.02 ESTABLISHMENT WORK

A. Keep turf and grasses in a healthy growing condition in accordance with the Landscape Standards throughout the establishment period and submit Life Time Landscape Contractor Inspection Reports. Perform turf and grass establishment work throughout the growing seasons and as necessary during the dormant seasons (as defined by Landscape Architect). The Landscape Architect may perform inspections throughout the PEP to verify compliance. The Landscape Architect will consider the Contractor non-compliant if the Contractor does not maintain turf and grasses throughout the PEP and does not submit Inspection reports.

B. All Turf and Grasses:
1. In Turf and Grass establishment work, perform the following:
2. Inspect to assess the condition of the turf and grasses and the site and factors that may influence turf and grass health, vigor, and establishment success. Inspect these conditions at

least every two weeks during the growing season and at least every month during the dormant season;

3. Submit a written Inspection report to the Landscape Architect via e-mail by the 1st and 15th of each month during the growing season and by the 1st of each month during the dormant season. The Landscape Architect will use the report-frequency and content to assess plant establishment compliance. The report may include scanned copies of the plan sheets with the Contractor notes, copies of the report form found in the Life Time Landscape Standards Manual. Include the following in the report:
    a. The project number;
    b. Engineer's name;
    c. Name of Contractor's responsible scout or representative;
    d. Dates work was performed;
    e. Work locations;
    f. Work completed;
    g. Prevailing weather conditions;
    h. Soil moisture assessments;
    i. Insect, animal, vehicular, weather, or other damage;
    j. Disease problems;
    k. Treatment recommendations' and
    l. Assessment of overall plant conditions including weed competition and control.
4. Maintain soil moisture in accordance with the watering guidelines of the standard planting details shown on the plans.
5. Maintain healthy, vigorous turf and grass. free of harmful insects, fungus, and disease.
6. Repair dead, dying, and unsightly turf and grass. Provide and install replacement turf and grass in accordance with Replacement Requirements and according to Construction Drawings and Specifications.
7. Maintain turf and grass areas in a weed-free condition as follows:
    a. Remove weeds, top growth and roots, within the turf and grass limits.
    b. Do not spray chemicals for weed control in mulched planting areas during the PEP. The Contractor may apply a non-selective, non-residual post-emergent herbicide containing 41 percent glyphosate, as the active ingredient with a surfactant on a spot treatment basis with a brush or wick applicator. The Contractor may also apply a broad-spectrum dichlobenil based granular, pre-emergent herbicide in accordance with product labeling and manufacturer's recommendations;
    c. Do not weed whip or weed clip as weed control.
8. Prevent or repair rutting and other damage that may lead to soil erosion and weed infestation.
9. Perform turf and grass establishment operations consistent with plant care and horticultural practices detailed in the Life Time Landscape Standards.
10. Remove excess material, obsolete temporary erosion control devices, rocks, and debris from the project.

C. Replacement requirements:
    1. Within the first half of the PEP, determine which turf and grass need replacing. Replace dead, defective turf and grass and incidental materials in accordance with initial installation requirements, including turf and grass lost due to accidents, vandalism, theft, rodent and pest damage, damage caused by the Contractor, or if ordered by the Landscape Architect or Facilities Manager, at no additional cost to the Owner. Conduct turf and grass replacement operations as needed within the first half of the PEP. At least one week before turf and grass replacement, submit a summary report of proposed turf and grass replacements to the Landscape Architect and Facilities Manager. Include by attachment, copies of plan sheets with the proposed replacement quantities and locations identified and a Life Time Certificate of Compliance for Turf and Grass, Landscape Material, and Equipment, in the report. Using brightly colored paint, mark on site turf and grass requiring replacement. Provide replacement turf and grass and incidental materials that are equal to and the same as the initial material required by the contract.

D. Final Acceptance:

a. As a condition for terminating the PEP and conducting the final inspection, the Landscape Architect and Facility Manager may require the Contractor to bring the turf and grass establishment work into compliance. At the end of the PEP, the Landscape Architect and Facility Manager along with the Establishment Contractor will perform a final inspection of the project.

E. Transition to Long Term Maintenance:

1. Upon final acceptance, the project will transition from Establishment Contractor care of turf and grass to Long Term Maintenance. A coordination meeting to transition from the Establishment Contractor to Long-Term Maintenance Contractor will take place one week prior to conclusion of the Establishment period to ensure all requirements are met and the Long-Term Contractor understands their role and when they will take over Maintenance.

END OF SECTION

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SECTION 32 93 00
PLANTS

PART 1 GENERAL

1.01 DESCRIPTION

A. This work consists of providing, planting, and establishing trees, shrubs, vines, and perennials of the species, variety, grade, size, or age, and root category specified for the locations shown on the plans.

1.02 SUMMARY

A. Section Includes:
   1. Plants.
   2. Planting soils.
   3. Tree stabilization.
   4. Landscape edgings.
   5. Tree grates.

1.03 RELATED SECTIONS:

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Section 01 33 00 - Submittal Procedures

C. Section 01 40 00 - Quality Requirements

D. Section 01 60 00 - Product Requirements

E. Section 31 10 00 - Site Clearing: for protection of existing trees and plantings, topsoil stripping and stockpiling, and site clearing.

F. Section 31 23 00 - Excavation and Fill: for excavation, filling, and rough grading and for subsurface aggregate drainage and drainage backfill materials.

G. Section 32 33 00 - Site Furnishings: for exterior unit planters.

H. Section 32 92 00 - Turf and Grasses: for turf (lawn) and meadow planting, hydroseeding, and erosion-control materials.

1.04 REFERENCE STANDARDS

A. ANSI/AHIA Z60.1 - American National Standard for Nursery Stock; 2014.

B. ASME B18.6.1 - Wood Screws; 2016.

C. ASTM A48/A48M - Standard Specification for Gray Iron Castings; 2022.

D. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire; 2019.

E. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

F. ASTM C602 - Standard Specification for Agricultural Liming Materials; 2023.

G. ASTM D5268 - Standard Specification for Topsoil Used for Landscaping and Construction Purposes; 2023.

H. USDA Handbook no. 60 - Diagnosis and Improvement of Saline and Alkali Soils; Current Edition.

1.05 UNIT PRICES

A. Provide Unit prices as follows:
   1. Unit prices apply to authorized work covered by quantity allowances.
   2. Unit prices apply to additions to and deletions from Work as authorized by Change Orders.

1.06 DEFINITIONS

A. Backfill: The earth used to replace or the act of replacing earth in an excavation.

B. Balled and Burlapped Stock: Plants dug with firm, natural balls of earth in which they were grown, with ball size not less than diameter and depth recommended by ANSI/AHIA Z60.1 for type and size of

plant required; wrapped with burlap, tied, rigidly supported, and drum laced with twine with the root flare visible at the surface of the ball as recommended by ANSI/AHIA Z60.1.

C. Balled and Potted Stock: Plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than diameter and depth recommended by ANSI/AHIA Z60.1 for type and size of plant required.

D. Bare-Root Stock: Plants with a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not less than minimum root spread according to ANSI/AHIA Z60.1 for type and size of plant required.

E. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI/AHIA Z60.1 for type and size of plant required.

F. Duff Layer: The surface layer of native topsoil that is composed of mostly decayed leaves, twigs, and detritus.

G. Fabric Bag-Grown Stock: Healthy, vigorous, well-rooted plants established and grown in-ground in a porous fabric bag with well-established root system reaching sides of fabric bag. Fabric bag size is not less than diameter, depth, and volume required by ANSI/AHIA Z60.1 for type and size of plant.

H. Finish Grade: Elevation of finished surface of planting soil.

I. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

J. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

K. Pests: Living organisms that occur where they are not desired, or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), mammals (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

L. Planting Area: Areas to be planted.

M. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

N. Plant; Plants; Plant Material: These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.

O. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.

P. Stem Girdling Roots: Roots that encircle the stems (trunks) of trees below the soil surface.

Q. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

R. Subsoil: All soil beneath the topsoil layer of the soil profile and typified by the lack of organic matter and soil organisms.

S. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.

1.07 SUBMITTALS

A. Product Data: For each type of product indicated, including soils.
   1. Plant Materials: Include quantities, sizes, quality, and sources for plant materials.
   2. Pesticides and Herbicides: Include product label and manufacturer's application instructions specific to the Project.
   3. Plant Photographs: Include color photographs in digital 3- by 5-inch format of each required species and size of plant material as it will be furnished to the Project. Take photographs from an

angle depicting true size and condition of the typical plant to be furnished. Include a scale rod or other measuring device in each photograph. For species where more than 20 plants are required, include a minimum of three photographs showing the average plant, the best quality plant, and the worst quality plant to be furnished. Identify each photograph with the full scientific name of the plant, plant size, and name of the growing nursery.

B. Samples for Verification: For each of the following:
   1. Organic Mulch: 1-pint volume of each organic mulch required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.
   2. Mineral Mulch: 2 lb of each mineral mulch required, in sealed plastic bags labeled with source of mulch. Sample shall be typical of the lot of material to be delivered and installed on the site; provide an accurate indication of color, texture, and makeup of the material.
   3. Weed Control Barrier: 12 by 12 inches.
   4. Edging Materials and Accessories: Manufacturer's standard size, to verify color selected.
   5. Tree Grates and Accessories: Manufacturer's standard size delivered to the site for review, to verify design and color selected.
   6. Root Barrier: Width of panel by 12 inches.

C. Procurement:
   1. Submit proof of procurement for all materials within 30 days of product submittal approval. Include proof of payment, delivery schedule and storage information.
   2. Submit inventory to Owner within 5 days of delivery of materials.
   3. See Sections 01 33 00 and 01 60 00.

1.08 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified landscape Installer. Include list of five(5) similar projects completed by Installer in last three years, demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include references from owner and names and addresses of owners' contact persons.

B. Product Certificates: For each type of manufactured product, from manufacturer, and complying with the following:
   1. Manufacturer's certified analysis of standard products.
   2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.

C. Material Test Reports: For standardized ASTM D5268A topsoil, existing native surface topsoil and imported or manufactured topsoil.

D. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of plants during a calendar year. Request Landscape Standards Document for Establishment before start of required Establishment periods.

E. Warranty: Two-year warranty on all plants and materials from substantial completion.

1.09 QUALITY ASSURANCE

A. Manufacturers and Installers shall satisfy minimum qualifications listed in Section 01 40 00 in addition to the requirements below.

B. Installer Qualifications: A qualified landscape Installer whose work has resulted in successful establishment of plants.
   1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
   2. Experience: Five years' minimum experience in landscape installation in addition to requirements in Section 01 40 00 "Quality Requirements."
   3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.

4. Personnel Certifications: Installer's field supervisor or personnel assigned to the Work shall have certification from the Professional Landcare Network as a Certified Landscape Technician - Exterior, with installation, maintenance, irrigation specialty area(s), designated CLT-Exterior.
5. Pesticide Applicator: State licensed, commercial.

C. Soil-Testing Laboratory Qualifications: An independent or university laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.

D. Soil Analysis: For each unamended soil type, furnish soil analysis and a written report by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; sodium absorption ratio; deleterious material; pH; and mineral and plant-nutrient content of the soil.
1. Testing methods and written recommendations shall comply with USDA Handbook no. 60.
2. The soil-testing laboratory shall oversee soil sampling; with depth, location, and number of samples to be taken per instructions from Architect. A minimum of three representative samples shall be taken from varied locations for each soil to be used or amended for planting purposes.
3. Report suitability of tested soil for plant growth.
    a. Based upon the test results, state recommendations for soil treatments and soil amendments to be incorporated. State recommendations in weight per 1000 sq. ft. or volume per cu. yd. for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.
    b. Report presence of problem salts, minerals, or heavy metals, including aluminum, arsenic, barium, cadmium, chromium, cobalt, lead, lithium, and vanadium. If such problem materials are present, provide additional recommendations for corrective action.

E. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI/AHIA Z60.1.
1. Selection of plants purchased under allowances will be made by Architect, who will tag plants at their place of growth before they are prepared for transplanting.

F. Measurements: Measure according to ANSI/AHIA Z60.1. Do not prune to obtain required sizes.
1. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 above the root flare for trees up to 4-inch caliper size, and 12 inches above the root flare for larger sizes.
2. Other Plants: Measure with stems, petioles, and foliage in their normal position.

G. Plant Material Observation: Architect may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Architect retains right to observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.
1. Notify Architect of sources of planting materials one week in advance of delivery to site and provide the Landscape Architect with the following:
    a. A copy of a valid nursery stock, dealer or grower certificate, registered with the State Department of Agriculture, a current nursery certificate or license from a state or provincial Department of Agriculture for each plant stock supplier, or both;
    b. Documentation certifying that plant material shipped from out-of-state nursery vendors subject to state and federal quarantines, is free of currently regulated pests, including Emerald Ash Borers, and Gypsy Moths. To determine if State vendors are subject to quarantines, call the State Supervisor of Nursery Inspection and Export Certification; and
    c. An updated Certificate of Compliance, signed by the Contractor’s authorized representative.

H. Preinstallation Conference: Conduct conference at the Project site with the Landscape Architect, Construction Project Manager and Landscape Contractor, job captain and key installation specialists.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws if applicable.
   1. Upon delivery of plant stock and materials to the project, provide the Landscape Architect with the following:
      1) Bills of lading or shipping documents for plant stock and landscape materials delivered to the project, and
      2) An updated and signed Certificate of Compliance, if necessary, to reflect deviations from the original Certificate of Compliance documentation submitted at or before the preconstruction conference.
   2. As a condition for authorization of payments, provide the Landscape Architect with vendor invoices or billing statements for plant stock and materials used on the project.
   3. The Landscape Architect will consider work performed with plant stock, materials, or equipment that was misrepresented in the documentation, as unauthorized work.

B. Bulk Materials:
   1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
   2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
   3. Accompany each delivery of bulk fertilizers and soil amendments with appropriate certificates.

C. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.

D. Handle planting stock by root ball.

E. Store bulbs, corms, and tubers in a dry place at 60 to 65 deg F until planting.

F. Deliver plants after preparations for planting have been completed and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.
   1. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
   2. Do not remove container-grown stock from containers before time of planting.
   3. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly-wet condition.

1.11 PROJECT CONDITIONS

A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.

B. Interruption of Existing Services or Utilities: Do not interrupt services or utilities to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary services or utilities according to requirements indicated:
   1. Notify Landscape Architect and Construction Manager no fewer than two days in advance of proposed interruption of each service or utility.
   2. Do not proceed with interruption of services or utilities without Construction Manager's written permission.

C. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with maintenance periods to provide required establishment from date of Substantial Completion. Plants installed outside dates listed below will not be paid for or evaluated for payment until 1 full growing

season has elapsed. This condition may affect final payment for work. Do not move or plant coniferous evergreen materials after bud break or during conditions of new growth.

1. Deciduous B&B and Potted Plants: April 15th to June 15th: Aug. 21 – Nov. 15
2. Coniferous Evergreen B&B and Potted Plants: April 15 to bud break; Aug 21 to Sept. 30
3. Landscape Architect to verify local planting restrictions to region.

D. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.

E. Coordination with Turf Areas (Lawns): Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.
   1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.

1.12 WARRANTY

A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner, or incidents that are beyond Contractor's control.
      b. Structural failures including plantings falling or blowing over.
      c. Faulty performance of tree stabilization, edgings, tree grates.
      d. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
   2. Warranty Periods from Date of Substantial Completion:
      a. Trees, Shrubs, Vines, and Ornamental Grasses: Twelve (12) months.
      b. Ground Covers, Biennials, Perennials, and Other Plants: Twelve(12) months.
      c. Annuals: Three(3) months.
   3. Include the following remedial actions as a minimum:
      a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
      b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
      c. A limit of one replacement of each plant will be required except for losses or replacements due to failure to comply with requirements.
      d. Provide extended warranty for period equal to original warranty period, for replaced plant material.

1.13 ESTABLISHMENT SERVICES

A. Plant Establishment Period for Trees, Ground Cover and Other Plants: Provide maintenance by skilled employees of landscape Installer. Maintain as required in Part Four. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established but for not less than maintenance period below.
   1. 2 calendar years.

B. Continuing Long Term Maintenance Proposal: May be requested from the Owner to have the Installer provide, in the form of a standard yearly (or other period) maintenance agreement, starting on date initial Establishment service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

PART 2 PRODUCTS

2.01 PLANT MATERIAL

A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant Schedule or Plant Legend shown on Drawings and complying with ANSI/AHIA Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf

and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

1. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than 3/4 inch in diameter; or with stem girdling roots will be rejected.
2. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.

B. Provide plants of sizes, grades, and ball or container sizes complying with ANSI/AHIA Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Architect, with a proportionate increase in size of roots or balls.

C. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which shall begin at root flare according to ANSI/AHIA Z60.1. Root flare shall be visible before planting.

D. Labeling: Label each plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant as shown on Drawings.

E. If formal arrangements or consecutive order of plants is shown on Drawings, select stock for uniform height and spread, and number the labels to assure symmetry in planting.

F. Annuals and Biennials: Provide healthy, disease-free plants of species and variety shown or listed, with well-established root systems reaching to sides of the container to maintain a firm ball, but not with excessive root growth encircling the container. Provide only plants that are acclimated to outdoor conditions before delivery and that are in bud but not yet in bloom.

2.02 INORGANIC SOIL AMENDMENTS

A. Lime: ASTM C602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:

1. Class: T, with a minimum of 99 percent passing through No. 8 sieve and a minimum of 75 percent passing through No. 60 sieve.
2. Class: O, with a minimum of 95 percent passing through No. 8 sieve and a minimum of 55 percent passing through No. 60 sieve.
3. Provide lime in form of any of these local ground materials including dolomitic limestone, calcitic limestone, mollusk shells.

B. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent sulfur, with a minimum of 99 percent passing through No. 6 sieve and a maximum of 10 percent passing through No. 40 sieve.

C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.

D. Aluminum Sulfate: Commercial grade, unadulterated.

E. Perlite: Horticultural perlite, soil amendment grade.

F. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through No. 50 sieve.

G. Sand: Clean, washed, natural or manufactured, and free of toxic materials.

H. Diatomaceous Earth: Calcined, 90 percent silica, with approximately 140 percent water absorption capacity by weight.

I. Zeolites: Mineral clinoptilolite with at least 60 percent water absorption by weight.

2.03 ORGANIC SOIL AMENDMENTS

A. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1/2-inch sieve; soluble salt content of 5 to 10 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:

1. Organic Matter Content: 50 to 60 percent of dry weight.

2. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.

B. Sphagnum Peat: Partially decomposed sphagnum peat moss, finely divided or granular texture, with a pH range of 3.4 to 4.8.

C. Muck Peat: Partially decomposed moss peat, native peat, or reed-sedge peat, finely divided or of granular texture, with a pH range of 6 to 7.5, and having a water-absorbing capacity of 1100 to 2000 percent.

D. Wood Derivatives: Decomposed, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture and free of chips, stones, sticks, soil, or toxic materials.
1. In lieu of decomposed wood derivatives, mix partially decomposed wood derivatives with ammonium nitrate at a minimum rate of 0.15 lb/cu. ft. of loose sawdust or ground bark, or with ammonium sulfate at a minimum rate of 0.25 lb/cu. ft. of loose sawdust or ground bark.

E. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, debris, and material harmful to plant growth.

2.04 FERTILIZERS

A. Bonemeal: Commercial, raw or steamed, finely ground; a minimum of 4 percent nitrogen and 20 percent phosphoric acid.

B. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.

C. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
1. Composition: 1 lb/1000 sq. ft. of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

D. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

E. Planting Tablets: Tightly compressed chip type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.
1. Size: 10-gram tablets.
2. Nutrient Composition: 20 percent nitrogen, 10 percent phosphorous, and 5 percent potassium, by weight plus micronutrients.

F. Chelated Iron: Commercial-grade FeEDDHA for dicots and woody plants, and commercial-grade FeDTPA for ornamental grasses and monocots.

2.05 PLANTING SOILS

A. Planting Soil: ASTM D5268 topsoil, with pH range of 5.5 to 7, a minimum of 6 percent organic material content; free of stones 1/2 inch or larger in any dimension and other extraneous materials harmful to plant growth. Mix ASTM D5268 topsoil with soil amendments and fertilizers in quantities, as directed by qualified soil testing lab, to produce planting soil.

B. Planting Soil: Existing, native surface topsoil formed under natural conditions with the duff layer retained during excavation process and stockpiled on-site. Verify suitability of native surface topsoil to produce viable planting soil by testing. Clean soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.

1. Supplement with another specified planting soil when quantities are insufficient.
2. Mix existing, native surface topsoil with soil amendments and fertilizers in quantities, as directed by qualified soil testing lab, to produce planting soil.

C. Planting Soil: Imported topsoil or manufactured topsoil from off-site sources. Obtain topsoil displaced from naturally well-drained construction or mining sites where topsoil occurs at least 4 inches deep; do not obtain from agricultural land, bogs, or marshes.
   1. Additional Properties of Imported Topsoil or Manufactured Topsoil: Screened and free of stones 1/2 inch or larger in any dimension; free of roots, plants, sod, clods, clay lumps, pockets of coarse sand, paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials harmful to plant growth; free of obnoxious weeds and invasive plants including quackgrass, Johnsongrass, poison ivy, nutsedge, nimblewill, Canada thistle, bindweed, bentgrass, wild garlic, ground ivy, perennial sorrel, and bromegrass; not infested with nematodes; grubs; or other pests, pest eggs, or other undesirable organisms and disease-causing plant pathogens; friable and with sufficient structure to give good tilth and aeration. Continuous, air-filled pore space content on a volume/volume basis shall be at least 15 percent when moisture is present at field capacity. Soil shall have a field capacity of at least 15 percent on a dry weight basis.
   2. Mix imported topsoil or manufactured topsoil with soil amendments and fertilizers in quantities, as directed by qualified soil testing lab, to produce planting soil.

D. Lightweight On-Structure Planting Soil: Mix produced by modifying planting soil or by a custom blend to produce a lightweight soil for rooftop applications. Brand and type to be specified by the project Landscape Architect to fit planting conditions.

2.06 MULCHES

A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:
   1. Type: Shredded hardwood mulch or approved equal used as a 3-inch top dressing in all plant beds and around trees as shown in construction details.
   2. Size Range: 3 inches maximum, 1/2 inch minimum.
   3. Color: Natural.

B. Mineral Mulch: Hard, durable stone, washed free of loam, sand, clay, and other foreign substances, of following type, size range, and color:
   1. Type: Rounded riverbed gravel or smooth-faced stone, Crushed stone or gravel, Granite chips.
   2. Size Range: Varies, as specified in construction details.
   3. Color: Uniform color range acceptable to Landscape Architect.

2.07 WEED-CONTROL BARRIERS

A. Nonwoven Geotextile Filter Fabric: Polypropylene or polyester fabric, 3 oz./sq. yd. minimum, composed of fibers formed into a stable network so that fibers retain their relative position. Fabric shall be inert to biological degradation and resist naturally-encountered chemicals, alkalis, and acids.

2.08 PESTICIDES

A. General: Pesticide registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

B. Pre-Emergent Herbicide (Selective and Non-Selective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

C. Post-Emergent Herbicide (Selective and Non-Selective): Effective for controlling weed growth that has already germinated.

2.09 TREE STABILIZATION MATERIALS

A. Stakes and Guys:

1. Upright and Guy Stakes: Stakes shall be six-foot steel “T” fencing post. Three (3) posts per tree.
2. Guys and Tie Wires: ASTM A641/A641M, Class 1, galvanized-steel wire, two-strand, twisted, 0.106 inch in diameter.
3. Tree-Tie Webbing: UV-resistant polypropylene or nylon webbing with brass grommets.
4. Guy Cables: Five-strand, 3/16-inch-diameter, galvanized-steel cable, Hose shall be two-ply fiber-bearing rubber garden hose, not less than ½-inch inside diameter, black or green, and of suitable length.
5. Flags: Standard surveyor's plastic flagging tape, white, 6 inches long.

B. Root-Ball Stabilization Materials:
1. Upright Stakes and Horizontal Hold-Down: Rough-sawn, sound, new hardwood or softwood, free of knots, holes, cross grain, and other defects, 2-by-2-inch nominal by length indicated; stakes pointed at one end.
2. Wood Screws: ASME B18.6.1.
3. Proprietary Root-Ball Stabilization Devices: Proprietary at- or below-grade, or on structure stabilization systems as specified by the Landscape Architect, to secure each new planting by root ball; sized per manufacturer's written recommendations unless otherwise indicated.

C. Palm Bracing: Battens or blocks, struts, straps, and protective padding as indicated.
1. Battens or Blocks and Struts: Rough-sawn, sound, new hardwood or softwood, free of knots, holes, cross grain, and other defects, 2-by-4-inch nominal by lengths indicated.
2. Straps: Adjustable steel or plastic package banding straps.
3. Padding: Burlap.
4. Proprietary Palm-Bracing Devices: Proprietary systems as specified by the Landscape Architect, to secure each new planting by trunk; sized per manufacturer's written recommendations unless otherwise indicated.

2.10 LANDSCAPE EDGINGS

A. Aluminum Edging: Standard-profile extruded-aluminum edging, ASTM B221, Alloy 6063-T6, fabricated in standard lengths with interlocking sections with loops stamped from face of sections to receive stakes.
1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Edging Size: 3/16 inch wide by 5-1/2 inches deep.
3. Stakes: Aluminum, ASTM B221, Alloy 6061-T6, approximately 1-1/2 inches wide by 12 inches long.
4. Finish: Mill (natural aluminum) or Black anodized.

2.11 TREE GRATES

A. Tree Grates and Frames: ASTM A48/A48M, Class 35 or better, aluminum or gray-iron castings of shape, pattern, finish and size indicated.

2.12 MISCELLANEOUS PRODUCTS

A. Wood Pressure-Preservative Treatment: AWPA C2, with waterborne preservative for soil and freshwater use, acceptable to authorities having jurisdiction, and containing no arsenic; including ammoniacal copper arsenate, ammoniacal copper zinc arsenate, and chromated copper arsenate.

B. Root Barrier: Black, molded, modular panels manufactured with 50 percent recycled polyethylene plastic with ultraviolet inhibitors, 85 mils thick, and each panel 18 inches to 24 inches wide.

C. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's written instructions.

D. Burlap: Non-synthetic, biodegradable.

E. Mycorrhizal Fungi: Dry, granular inoculant containing at least 5300 spores per lb of vesicular-arbuscular mycorrhizal fungi and 95 million spores per lb of ectomycorrhizal fungi, 33 percent hydrogel, and a maximum of 5.5 percent inert material.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas to receive plants for compliance with requirements and conditions affecting installation and performance.
   1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
   2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.
   3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
   4. Uniformly moisten excessively dry soil that is not workable and which is too dusty.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

3.02 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

C. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Architect's acceptance of layout before excavating or planting. Make minor adjustments as required.

D. Lay out plants at locations directed by Architect. Stake locations of individual trees and shrubs and outline areas for multiple plantings.

E. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.
   1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.

F. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.

3.03 PLANTING AREA ESTABLISHMENT

A. Loosen subgrade of planting areas to a minimum depth of 6 inches. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
   1. Apply fertilizer directly to subgrade before loosening.
   2. Thoroughly blend planting soil off-site before spreading.
      a. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.
      b. Mix lime with dry soil before mixing fertilizer.
   3. Spread planting soil to a depth of 12 inches but not less than required to meet finish grades after natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.
      a. Spread approximately one-half the thickness of planting soil over loosened subgrade. Mix thoroughly into top 4 inches of subgrade. Spread remainder of planting soil.

B. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

C. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

D. Application of Mycorrhizal Fungi: At time directed by Architect, broadcast dry product uniformly over prepared soil at application rate indicated on Drawings.

3.04 EXCAVATION FOR TREES AND SHRUBS

A. Planting Pits and Trenches: Excavate circular planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are not acceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.
   1. Excavate approximately three times as wide as ball diameter for balled and burlapped grown stock.
   2. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
   3. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling.
   4. Maintain required angles of repose of adjacent materials as shown on the Drawings. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
   5. Maintain supervision of excavations during working hours.
   6. Keep excavations covered or otherwise protected when unattended by Installer's personnel.
   7. If drain tile is shown on Drawings or required under planting areas, excavate to top of porous backfill over tile.

B. Subsoil and topsoil removed from excavations may not be used as planting soil.

C. Obstructions: Notify Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.
   1. Hardpan Layer: Drill 6-inch- diameter holes, 24 inches apart, into free-draining strata or to a depth of 10 feet, whichever is less, and backfill with free-draining material.

D. Drainage: Notify Architect if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.

E. Fill excavations with water and allow to percolate away before positioning trees and shrubs.

F. Planting Percolation Test: A minimum of two tests, per development site is required. Mark testing locations with visible stake. Prior to testing, submit site plan with proposed test locations marked for approval by Landscape Architect. Additional tests may be needed as required by Landscape Architect.
   1. Fill planting hole with water and allow it to drain completely.
   2. Hardpan Layer: Drill 6-inch diameter holes, 24 inches apart, into Hardpan Layer
   3. Fill planting hole with water again and immediately measure the depth of the water in the pit with a ruler. Record the time.
   4. After 15 minutes have passed, measure the depth of the water in the pit again.
   5. Multiply the number of inches that have drained by 4 to get drainage in inches per hour.
   6. Drainage will fall into one of three categories:
      a. Poorly drained = less than 2” per hour
      b. Well drained = 3” to 6” per hour
      c. Excessively drained = more than 6” per hour
   7. Prepare written test results and submit to Landscape Architect. If soils are poorly drained, immediately notify Landscape Architect of this condition. Upon direction, contractor shall install a drain stack at the bottom of the planting pit. Auger a 4” minimum diameter hole to a depth of 42” from the bottom of the plant pit and fill it with ¾” gravel. Cover the gravel with filter fabric and install plant material as directed.

3.05 TREE, SHRUB, AND VINE PLANTING

A. Install plants in accordance with the steps and requirements in the standard planting details shown on the plans and specific to each plant stock type.

B. Before planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.

C. Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.

D. Set stock plumb and in center of planting pit or trench with root flare 1 inch above adjacent finish grades.
   1. Use planting soil for backfill.
   2. After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
   3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
   4. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside the root ball about 1 inch from root tips; do not place tablets in bottom of the hole.
   5. Continue backfilling process. Water again after placing and tamping final layer of soil.

E. When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.

3.06 MECHANIZED TREE SPADE PLANTING

A. Trees may be planted with an approved mechanized tree spade at the designated locations. Do not use tree spade to move trees larger than the maximum size allowed for a similar field-grown, balled-and-burlapped root-ball diameter according to ANSI Z60.1, or larger than the manufacturer's maximum size recommendation for the tree spade being used, whichever is smaller.

B. When extracting the tree, center the trunk within the tree spade and move tree with a solid ball of earth.

C. Cut exposed roots cleanly during transplanting operations.

D. Use the same tree spade to excavate the planting hole as was used to extract and transport the tree.

E. Plant trees as shown on Drawings, following procedures in "Tree, Shrub, and Vine Planting" Article.

F. Where possible, orient the tree in the same direction as in its original location.

3.07 TREE, SHRUB, AND VINE PRUNING

A. Remove only dead, dying, or broken branches. Do not prune for shape.

B. Prune, thin, and shape trees, shrubs, and vines as directed by Architect.

C. Prune, thin, and shape trees, shrubs, and vines according to standard professional horticultural and arboricultural practices. Unless otherwise indicated by Architect, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.

D. Do not apply pruning paint to wounds.

3.08 TREE STABILIZATION

A. Install trunk stabilization as follows unless otherwise indicated:
   1. Upright Staking and Tying: Stake trees of 2- through 5-inch caliper. Stake trees of less than 2-inch caliper only as required to prevent wind tip out. Use a minimum of three stakes of length required to penetrate at least 18 inches below bottom of backfilled excavation and to extend one-third of trunk height above grade. Set vertical stakes and space to avoid penetrating root balls or root masses.

B. Staking and Guying: Stake and guy trees more than 14 feet in height and more than 2 inches in caliper unless otherwise indicated. Securely attach no fewer than three guys to stakes 30 inches long, driven to grade.

C. Root-Ball Stabilization: Install at- or below-grade stabilization system to secure each new planting by the root ball unless otherwise indicated.
   1. Proprietary Root-Ball Stabilization Device: Install root-ball stabilization system sized and positioned as recommended by manufacturer unless otherwise indicated and according to manufacturer's written instructions.

D. Palm Bracing: Install bracing system at three or more places equally spaced around perimeter of trunk to secure each palm until established unless otherwise indicated.
   1. Proprietary Palm-Bracing Device: Install palm-bracing system sized and positioned as recommended by manufacturer unless otherwise indicated and according to manufacturer's written instructions.

3.09 ROOT-BARRIER INSTALLATION

A. Install root barrier to protect paving or other hardscape elements, such as walls, curbs, and walkways as shown on Drawings.

3.10 PLANTING IN PLANTERS

A. Place a layer of drainage gravel at least 4 inches thick in bottom of planter. Cover bottom with filter fabric and wrap filter fabric 6 inches up on all sides. Duct tape along the entire top edge of the filter fabric, to secure the filter fabric against the sides during the soil-filling process.

B. Fill planter with lightweight planting soil as indicated on structure. Place soil in lightly compacted layers to an elevation of 1-1/2 inches below top of planter, allowing natural settlement.

3.11 GROUND COVER AND PLANT PLANTING

A. Set out and space ground cover and plants other than trees, shrubs, and vines as indicated in even rows with triangular spacing.

B. Use planting soil for backfill.

C. Dig holes large enough to allow spreading of roots.

D. For rooted cutting plants supplied in flats, plant each in a manner that will minimally disturb the root system but to a depth not less than two nodes.

E. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.

F. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.

G. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.12 PLANTING AREA MULCHING

A. Mulch backfilled surfaces of planting areas and other areas indicated.
   1. Trees in Turf Areas: Apply mulch ring of 3-inch average thickness, with radius around trunks or stems as shown on drawings. Do not place mulch within 3 inches of trunks or stems.
   2. Organic Mulch in Planting Areas: Apply 3-inch average thickness of organic mulch over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within 3 inches of trunks or stems.

3.13 WATERING

A. During Installation, provide watering equipment and forces on the project capable of completely watering plants as often as necessary to maintain soil moisture in the root zones.

B. Within two hours of installation, saturate the backfill soil of each plant with water. After settling, provide additional backfill to fill in the voids.

3.14 EDGING INSTALLATION

A. Aluminum Edging: Install aluminum edging where indicated according to manufacturer's written instructions. Anchor with aluminum stakes spaced approximately 36 inches apart, driven below top elevation of edging.

B. Shovel-Cut Edging: Separate mulched areas from turf areas with a 45-degree, 4- to 6-inch- deep, shovel-cut edge as shown on Drawings.

3.15 TREE GRATE INSTALLATION

A. Tree Grates: Set grate segments flush with adjoining surfaces as shown on Drawings. Shim from supporting substrate with soil-resistant plastic. Maintain a 3-inch- minimum growth radius around base of tree; break away units of casting, if necessary, according to manufacturer's written instructions.

3.16 PLANT MAINTENANCE

A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings. Spray or treat as required to keep trees and shrubs free of insects and disease.

B. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.

C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated past management practices whenever possible to minimize the use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

3.17 PESTICIDE APPLICATION

A. Apply pesticides and other chemical products and biological control agents in accordance with authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

B. Pre-Emergent Herbicides (Selective and Non-Selective): Apply to tree, shrub, and ground-cover areas in accordance with manufacturer's written recommendations. Do not apply to seeded areas.

C. Post-Emergent Herbicides (Selective and Non-Selective): Apply only as necessary to treat already-germinated weeds and in accordance with manufacturer's written recommendations.

3.18 RODENT PROTECTION

A. Place rodent protection around trees and other plant materials in accordance with standard planting details shown on the plans to mitigate damage.

3.19 CLEANUP AND PROTECTION

A. During planting, keep adjacent paving and construction clean and work area in an orderly condition.

B. Repair any damaged turf areas impacted during construction.

C. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

D. After installation and before Substantial Completion, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.

3.20 DISPOSAL

A. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.

3.21 DURATION OF MAINTENANCE

A. Maintenance of Turf and Grasses shall continue until Owner accepts that the processes listed above have been completed.

PART 4 PLANT ESTABLISHMENT PERIOD

4.01 ESTABLISHMENT PERIOD

A. Plant Establishment Period (PEP) begins on the date that initial planting operations (Substantial Completion) on the project are completed and continues until final acceptance of the project, and will last for the following period:
   1. 2 calendar years.

4.02 ESTABLISHMENT WORK

A. Keep plants in a healthy growing condition in accordance with the Landscape Standards throughout the establishment period and submit Life Time Landscape Contractor Inspection Reports. Perform plant establishment work throughout the growing seasons and as necessary during the dormant seasons (As defined by Landscape Architect). The Landscape Architect may perform inspections throughout the PEP to verify compliance. The Landscape Architect will consider the Contractor non-compliant if the Contractor does not maintain plants throughout the PEP and does not submit Inspection reports.

B. In plant establishment work, perform the following:
   1. Inspect to assess the condition of the plants and the planting site and factors that may influence plant health, vigor, and establishment success. Inspect these conditions at least every two weeks during the growing season and at least every month during the dormant season;
   2. Submit a written Inspection report to the Landscape Architect via e-mail by the 1st and 15th of each month during the growing season and by the 1st of each month during the dormant season. The Landscape Architect will use the report-frequency and content to assess plant establishment compliance. The report may include scanned copies of the plan sheets with the Contractor notes, copies of the report form found in the Life Time Landscape Standards Manual. Include the following in the report:
      a. The project number;
      b. Engineer's name;
      c. Name of Contractor's responsible scout or representative;
      d. Dates work was performed;
      e. Work locations;
      f. Work completed;
      g. Prevailing weather conditions;
      h. Soil moisture assessments;
      i. Insect, animal, vehicular, weather, or other damage;
      j. Disease problems;
      k. Treatment recommendations;
      l. Assessment of overall plant conditions including weed competition and control.
   3. Maintain soil moisture in accordance with the watering guidelines of the standard planting details shown on the plans.
   4. Repair, adjust, or replace staking and guying, mulch material, planting soil, rodent protection, seedling tree shelters, tree paint, and other incidental items in accordance with the plans.
   5. Maintain healthy, vigorous plants. free of harmful insects, fungus, and disease;
   6. Remove dead, dying, and unsightly plants. Provide and install replacement plants in accordance with Replacement Requirements and according to Construction Drawings and Specifications;
   7. Maintain plants in a plumb condition at the planting depth shown on the planting details in the plans;
   8. Maintain planting areas in a weed-free condition as follows:
      a. Remove weeds, top growth and roots, within the mulch limits by hand pulling. Pre-water mulched areas to ensure weed top growth and roots are entirely removed. Ensure weeding operations do not contaminate the mulch or project with weed seed, weed-laden soil or propagating weed parts. Remove State and County-regulated noxious weeds to at least 5 ft [900 mm] beyond the mulch limits. Remove weed parts or weed-laden material from the project to avoid the spread of weed infestations;

b. Do not spray chemicals for weed control in mulched planting areas during the PEP. The Contractor may apply a non-selective, non-residual post-emergent herbicide containing 41 percent glyphosate, as the active ingredient with a surfactant on a spot treatment basis with a brush or wick applicator. The Contractor may also apply a broad-spectrum dichlobenil based granular, pre-emergent herbicide in accordance with product labeling and manufacturer's recommendations;
c. Do not weed whip or weed clip as weed control;

9. Prune to remove dead, rubbing, damaged or diseased branches, unwanted suckers, and to improve plant form and structure;
10. Prevent or repair rutting and other damage that may lead to soil erosion and weed infestation;
11. Perform plant establishment operations consistent with plant care and horticultural practices detailed in the Life Time Landscape Standards.
12. Remove excess material, obsolete temporary erosion control devices, rocks, and debris from the project.

4.03 REPLACEMENT REQUIREMENTS

A. Within the first half of the PEP, determine which plants need replacing. Replace dead, defective, or missing plants and incidental materials in accordance with initial installation requirements, including plants lost due to accidents, vandalism, theft, rodent and pest damage, damage caused by the Contractor, or if ordered by the Landscape Architect, at no additional cost to the Owner. Conduct plant replacement operations as needed within the first half of the PEP. At least one week before plant replacement, submit a summary report of proposed plant replacements to the Architect. Include by attachment, copies of plan sheets with the proposed replacement quantities and locations identified and a Life Time Certificate of Compliance for Plant Stock, Landscape Material, and Equipment, in the report. Using brightly colored paint, mark on site plants requiring replacement. Provide replacement plants and incidental materials that are equal to or better than the initial material required by the contract.

4.04 FINAL ACCEPTANCE

A. As a condition for terminating the PEP and conducting the final inspection, the Landscape Architect and Facility Manager may require the Contractor to bring the plant establishment work into compliance. At the end of the PEP, the Landscape Architect and Facility Manager along with the Establishment Contractor will perform a final inspection of the project.

4.05 TRANSITION TO LONG TERM MAINTENANCE

A. Upon final acceptance, the project will transition from Establishment Contractor care of plantings to Long Term Maintenance. A coordination meeting to transition from the Establishment Contractor to Long-Term Maintenance Contractor will take place one week prior to conclusion of the Establishment period to ensure all requirements are met and the Long-Term Contractor understands their role and when they will take over Maintenance.

END OF SECTION

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SECTION 33 08 00
COMMISSIONING OF UTILITIES

PART 1 GENERAL

1.01 SUMMARY

A. This section includes specific requirements that apply to the implementation of the Commissioning Process and this Division Contractors' participation in this process. This section details the project specific equipment and systems that are included in the Commissioning Process. For general descriptions and responsibilities, refer to SECTION 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

1.02 RELATED DOCUMENTS

A. The Owner's Project Requirements (OPR) document.

B. The Basis of Design (BoD) document.

C. The Project Commissioning Plan (CxP) document.

D. ASHRAE Standard 202-2013 - Commissioning Process for Buildings and Systems.

E. LEED v4 for Building Design and Construction.

1.03 RELATED SECTIONS

A. SECTION 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS

B. SECTION 07 08 00 - COMMISSIONING OF THERMAL AND MOISTURE PROTECTION

C. SECTION 08 08 00 - COMMISSIONING OF OPENINGS

D. SECTION 11 08 00 - COMMISSIONING OF EQUIPMENT

E. SECTION 13 08 00 - COMMISSIONING OF SPECIAL CONSTRUCTION

F. SECTION 14 08 00 - COMMISSIONING OF CONVEYING SYSTEMS

G. SECTION 21 08 00 - COMMISSIONING OF FIRE SUPPRESSION SYSTEMS

H. SECTION 22 08 00 - COMMISSIONING OF PLUMBING SYSTEMS

I. SECTION 23 08 00 - COMMISSIONING OF MECHANICAL SYSTEMS

J. SECTION 25 08 00 - COMMISSIONING OF INTEGRATED AUTOMATION SYSTEMS

K. SECTION 26 08 00 - COMMISSIONING OF ELECTRICAL SYSTEMS

L. SECTION 27 08 00 - COMMISSIONING OF COMMUNICATIONS SYSTEMS

M. SECTION 28 08 00 - COMMISSIONING OF SAFETY AND SECURITY SYSTEMS

1.04 DEFINITIONS

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

1.05 RESPONSIBILITIES

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

PART 2 PRODUCTS

2.01 NO PRODUCTS SUPPLIED

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

B. Contractors and/or Vendors shall provide the specialty testing equipment necessary to fulfill the functional testing requirements, for the duration of the testing period.

PART 3 EXECUTION

3.01 GENERAL

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.02 MEETINGS

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.03 SYSTEM START-UP

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.04 PRE-FUNCTIONAL CHECKLISTS

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.05 FUNCTIONAL PERFORMANCE TESTING

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.06 TRAINING

A. For general descriptions, definitions, and responsibilities, refer to Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.

3.07 SYSTEMS TO BE COMMISSIONED

A. GENERAL
   1. Commissioning specifications supplement the requirements of individual specifications sections but shall not be interpreted to replace or diminish the specified scope of any individual section.
   2. For all systems listed below, Division Contractor shall comply with all commissioning requirements specified.

B. APPLICABLE SYSTEMS
   1. Water Service
   2. Sanitary Sewers
   3. Electrical Services
   4. Communication Services

END OF SECTION

SECTION 33 1116

SITE WATER UTILITY DISTRIBUTION PIPING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools and services required to fully complete all Site Utility work as required by the Drawings and/or specified herein including, but not limited to, the following described items:
   1. Perform trenching and backfilling required for work of this Section.
   2. Furnish and install piping for domestic water supply from water main to within 5 feet of building as described in Contract Documents complete with meter, shut-off valve, and connections.

1.02 RELATED REQUIREMENTS

A. Section 31 2316: Procedure and quality of excavating.

B. Section 31 2323: Procedure and quality of backfilling and compacting.

C. Herriman City Standards and Specifications.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Pipe:
   1. Type K copper meeting requirements of ASTM B 88 with wrought copper, brazed fittings.
   2. Blue-Brut by Ipex Inc

B. Water Meter: As required by local agency furnishing water.

C. Connection Material:
   1. Brazing Rods In accordance with ANSI / AWS A5.8:
      a. Classification BCuP-4 Copper Phosphorus (6 percent silver).
      b. Classification BCuP-5 Copper Phosphorus (15 percent silver).
      c. Classification BAg-5 Silver (45 percent silver).
      d. Do not use rods containing Cadmium.
   2. Flux:
      a. Approved Products:
         1) Stay-Silv white brazing flux by J W Harris Co, Cincinnati, OH (800) 733-4533 or (513) 891-2000. www.jwharris.com.
         2) High quality silver solder flux by Handy & Harmon, Fairfield, CT (800) 245-2728 or (203) 259-8321. www.handyharmon.com.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Excavate and backfill as specified in Sections 31 2316 and 31 2323 with following additional requirements:
   1. Runs shall be as close as possible to those shown on Drawings.
   2. Excavate to required depth.
   3. Bottom of trenches shall be hard. Tamp as required.

4. Install pipe bedding material per pipe manufacturer specifications.
5. Remove large stones over 4 inches in diameter which could damage piping or impede consistent backfilling or compaction.
6. Remove debris from trench before laying pipe.
7. Do not cut trenches near footings without consulting Architect.
8. Excavate trenches so outside pipe will be 48 inches minimum below finish grade.
9. Backfill only after pipe lines have been tested and inspected, and approved by Architect.

B. Completely eliminate cross connections, backflow, and water hammer.

C. Install shut-off valve at meter.

3.02 FIELD QUALITY CONTROL

A. Site Tests
   1. Sterilization And Negative Bacteriological Test:
      a. Sterilize potable water system with solution containing 200 parts per million minimum of available chlorine and maintaining a pH of 7.5 minimum. Introduce chlorinating materials into system in manner approved by Architect. Allow sterilization solution to remain for 24 hours and open and close valves and faucets several times during that time.
      b. After sterilization, flush solution from system with clean water until residual chlorine content is less than 0.2 parts per million.
      c. Water system will not be accepted until negative bacteriological test is made on water taken from system. Repeat dosing as necessary until such negative test is accomplished.
      d. Disinfection and bacteria testing must be approved by the governing agency prior to integration into the system.
   2. Pressure Test: Before covering pipes, test system in presence of Architect or governing agency at 200 psi hydrostatic pressure for two hours and show no leaks.

3.03 CLEANING

A. Remove excess earth from site or place as directed by Architect.

END OF SECTION 33 1116

SECTION 33 1119

FIRE SUPPRESSION UTILITY WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools and services required to fully complete all Fire Utility Piping work as required by the Drawings and/or specified herein including, but not limited to, the following described items:
   1. Perform excavation and backfill required for installation of work of this Section.
   2. Furnish and install fire water system as described in Contract Documents.
   3. Furnish and install connection to water main.

1.02 RELATED REQUIREMENTS

A. Section 31 2316: Procedure and quality of excavating.

B. Section 31 2323: Procedure and quality of backfilling and compacting.

C. Herriman Springs City Standards and Specifications.

1.03 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies:
   1. Install exterior fire water system according to NFPA 13, NFPA 24, and Cast Iron Pipe Research Institute Procedures unless specified otherwise below.
   2. Install exterior fire water system up to and including pipe flange 12-inches above floor inside building.

B. Pre-Installation Conference: Participate in pre-installation conference specified in Section 03 30000

PART 2 - PRODUCTS

2.01 MANUFACTURED UNITS

A. Pipe:
   1. Ductile iron pipe in accordance with ANSI A21.51 / AWWA C 151 and ANSI A21.50 / AWWA C 150.
   2. Blue-Brut by Ipex Inc

B. Fittings: Ductile iron pipe fitting in accordance with ANSI A21.10 / AWWA C 110 and rubber gaskets joints in accordance with ANSI A21.11 / AWWA C 111.

C. Hydrants:
   1. Class Two Quality Standard. See Section 01 6200.
      a. Hydrants accepted by authority having jurisdiction are approved.

D. Gate Valves:
   1. Cast iron body with bolted bonnet.
   2. Indicator post pattern.
   3. Non-rising stem.
   4. 175 psi working pressure.
   5. Approved Products:

a. Nibco:
    1) Model M-609 with mechanical connection.
    2) Model F-609 with flanged connection.
b. Mueller:
    1) Model A-2052-5 with mechanical connection.
    2) Model A-2052-6 with flanged connection.

E. Indicator Post Valve:
1. UL / ULC / FM Approved.
2. Adjustable type.
3. Cast iron body.
4. Approved Products:
    a. Nibco: Model NIP1A Vertical Post.
    b. Mueller: Model A-20800

F. Tamper Switch:
1. UL / ULC / FM Approved.
2. Weather and tamper resistant.
3. Single Pole Double Throw Switch.
4. Approved Product:
    a. Potter Electric Signal: Model PCVS

G. Fire Department Connection:
1. Free-standing type with cast brass angle body with polished chrome-plated finish.
2. Approved Manufacturers:
    a. Elkhart.
    b. Potter-Roemer.

H. Anchorages:
1. Provide anchorages for tees, plugs, caps, bends, and hydrants in accordance with NFPA 24.
2. Miscellaneous Fittings:
    a. Clamps, Straps, And Washers: Steel, meeting requirements of ASTM A 506.
    b. Rods: Steel, meeting requirements of ASTM A 575.
    c. Rod Couplings: Malleable iron, meeting requirements of ASTM A 197.
    d. Bolts: Steel, meeting requirements of ASTM A 307.
    e. Cast Iron Washers: Meeting requirements of ASTM A 126, Class A.
    f. Thrust Block: 3000 psi 17.237 Kpa concrete.

2.02 MANUFACTURERS

A. Contact Information:
1. Ipex Inc, Englewood, CO www.ipexinc.com.
2. Mueller Company, Decatur, IL www.muellerflo.com.
3. Nibco Inc, Elkhart, IN www.nibco.com.
4. Potter Electric Signal Company, St Louis, MO www.pottersignal.com.
5. Potter-Roemer, Santa Ana, CA www.potterroemer.com.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Before installation, inspect pipe for defects and cracks. Do not use defective, damaged, or unsound pipe.

3.02 PREPARATION

A. Excavate and backfill as specified in Sections 31 2316 and 31 2323 with following additional requirements:
   1. Runs shall be as close as possible to those shown on Drawings.
   2. Excavate to required depth.
   3. Grade to obtain fall required.
   4. Install pipe bedding material per pipe manufacturer specifications.
   5. Remove large stones over 4 inches in diameter which could damage piping or impede consistent backfilling or compaction.
   6. Bottom of trenches shall be hard. Tamp as required.
   7. Remove debris from trench prior to laying of pipe.
   8. Do not cut trenches near footings without consulting Architect.
   9. Excavate trenches so outside pipe will be 48-inches minimum finish grade.
   10. Cover pipe only after testing is complete and accepted by Architect.

3.03 INSTALLATION

A. General:
   1. When work is not in progress, close open ends of pipe and fittings so no trench water, soil, or other substances will enter pipes or fittings.
   2. Keep trenches free from water until pipe jointing material has set. Do not lay pipe when condition of trench or weather is unsuitable for such work.

B. Placing And Laying of Underground Pipe:
   1. The maximum allowable deflection of pipe joints shall be less than or equal to half of the manufacturer recommended maximum deflection.
   2. Laying:
      a. Install pipe bedding material per pipe manufacturer specifications.
      b. Remove large stones over 4 inches in diameter which could damage piping or impede consistent backfilling or compaction.
      c. Pipe laying shall proceed up-grade with spigot ends of bell-and-spigot pipe pointing in direction of flow.
      d. Lay each pipe true to line and grade and in such manner as to form close concentric joint with adjoining pipe and to prevent sudden offsets of flow line.
      e. Support fittings at bends in pipe line by concrete thrust blocks firmly wedged against vertical face of trench. Blocks shall be at sized per jurisdictional standards.
      f. As work progresses, clear interior of pipe of dirt and superfluous materials. Where cleaning after laying is difficult because of small pipe, keep suitable swab or drag in pipe and pull forward past each joint immediately after jointing has been completed.

C. Make joints between ductile iron and cast iron pipe and other types of pipe with standard manufactured cast-iron adapters and fittings.

D. Provide cast iron valve box for fire protection valve. Encase valve box in concrete.

E. Make joints between ductile iron and other types of pipe with standard manufactured adapters and fittings. Make connections between new work and existing mains using specials fittings to suit actual conditions.

F. Incidental Items of Work:
   1. Valve, plug, or cap, as directed by Architect, where pipe ends are left for future connections.
   2. Make key for unlocking valve handle identical to key used to open doors to building.

3.04 FIELD QUALITY CONTROL

A. Test system according to 'Contractor's Material & Test Certification for Underground Piping' NFPA 13, figure 1-10.1(b).2.

B. Pressure test at 200 psi static pressure for two hours or as required by local authority before covering.

END OF SECTION 33 1119

SECTION 33 3313

SANITARY UTILITY SEWERAGE

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools and services required to fully complete all Sanitary Sewer work as required by the Drawings and/or specified herein including, but not limited to, the following described items
   1. Perform excavating and backfilling required for work of this Section.
   2. Furnish and install sanitary sewage system complete as shown on Drawings. Begin sewer pipe within 5 feet of point where it enters building and connect to serving sewer system.

1.02 RELATED REQUIREMENTS

A. Section 31 2316: Quality of Excavation Requirements.

B. Section 31 2323: Quality of Fill Requirements

C. Jordan Basin Improvement District Standards and Specifications.

PART 2 - PRODUCTS

2.01 MATERIALS

A. PVC Pipe And Fittings:
   1. Gasket-joint gravity sewer pipe and fittings meeting requirements of ASTM D 3034 SDR-35 or ASTM F 789.
   2. Joints shall be integral wall bell and elastomeric gasket.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Before installation, inspect pipe for defects and cracks. Do not use defective, damaged, or unsound pipe.

3.02 PREPARATION

A. Excavate and backfill as specified in Sections 31 2316 and 31 2323 with following additional requirements:
   1. Runs shall be as close as possible to those shown on Drawings.
   2. Remove debris from trench before laying of pipe.
   3. Do not cut trenches near footings without consulting Architect.

3.03 INSTALLATION

A. General:
   1. When work is not in progress, close open ends of pipe and fittings so no trench water, soil, or other substances will enter pipes or fittings.
   2. Keep trenches free from water until pipe jointing material has set. Do not lay pipe when condition of trench or weather is unsuitable for such work.

3. Pipe:
    a. Width of trench at and below top of pipe shall be such that clear space between barrel of pipe and trench wall shall be between 12 and 18 inches on both sides of pipe.
    b. Grade of pipe and elevation shall match plans within ¼-inch, any variance from this shall be approved by Architect.
4. Appurtenances:
    a. Excavation for manholes and similar structures shall be sufficient to leave 12 inches minimum in clear between their outer surfaces and embankment or timber used to hold and protect banks.
    b. Over depth excavation below such appurtenances that has not been directed by Architect shall be considered unauthorized and be filled with sand, gravel, or concrete, as directed by Architect, and at no additional cost to Owner.

B. Placing And Laying of Underground Pipe:
1. If alignment requires deflection in excess of these limitations, provide special bends or sufficient number of shorter lengths of pipe to provide angular deflections within limits approved by Architect.
2. Laying:
    a. Shape trench bottom to give substantially uniform circumferential support to lower third of each pipe.
    b. Install pipe bedding material per pipe manufacturer specifications.
    c. Remove large stones over 4 inches in diameter which could damage piping or impede consistent backfilling or compaction.
    b. Pipe laying shall proceed up-grade with spigot ends of bell-and-spigot pipe pointing in direction of flow.
    c. Lay each pipe true to line and grade and in such manner as to form close concentric joint with adjoining pipe and to prevent sudden offsets of flow line.
    d. As work progresses, clear interior of pipe of dirt and superfluous materials. Where cleaning after laying is difficult because of small pipe, keep suitable swab or drag in pipe and pull forward past each joint immediately after jointing has been completed.
3. Make joints between cast iron pipe and other types of pipe with standard manufactured cast-iron adapters and fittings.
4. Valve, plug, or cap, as directed by Architect, where pipe ends are left for future connections.

3.04 FIELD QUALITY CONTROL

A. Tests: Do not backfill trenches until required pressure and other tests have been performed and until installed utility system conforms to requirements of Contract Documents.

3.05 CLEANING

A. Remove excess earth from site or place as directed by Architect.

END OF SECTION 33 3313

SECTION 33 4116

SITE STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools and services required to fully complete all Storm Piping work as required by the Drawings and/or specified herein including, but not limited to, the following described items
   1. Perform excavating and backfilling required for work of this Section.
   2. Furnish and install storm drainage system as described in Contract Documents from point of water collection to terminating point.

1.02 RELATED REQUIREMENTS

A. Section 31 2316: Procedure and quality of excavating.

B. Section 31 2323: Procedure and quality of backfilling and compacting.

PART 2 - PRODUCTS

2.01 MATERIAL

A. Bedding Material: 3/8 inch crushed gravel.

2.02 COMPONENTS

A. Catch Basins, Curb Inlets, Etc:
   1. Concrete:
      a. Construct of 4000 psi minimum concrete.
      b. Include cover inlet with cast iron frame and grate as shown on Drawings.
   2. PVC:
      a. Comply with requirements of ASTM D 3212. ASTM F 794, and ASTM F 1336.
      b. Metal grates, Frames, and hoods shall comply with ASTM A 536, Grade 70-50-05.
      c. Acceptable Products:
         1) Nyloplast-ADS, Buford, GA (866) 888-8479. www.nyloplast-us.com
         2) Equal as approved by Architect before bidding.

B. Concrete Pipe:
   1. Reinforced:
      a. Meet requirements of ASTM C 76, plain end.
      b. Determine class of pipe by depth of cover over pipe at rough-graded elevations as follows:

Depth Of Cover	Class Of Pipe
a. Under 2 feet	V
b. 2 feet to 3 feet	IV
c. 3 feet to 6 feet	III
d. Over 6 feet	II

C. PVC Pipe And Fittings:
   1. Meet requirements of ASTM D 3034, SDR 35.
   2. Fittings: Slip Joint type with elastomeric seals.

D. Corrugated Polyethylene Pipe And Fittings:
   1. Meet requirements of AASHTO M-252 or M-294, Type S.
      a. Corrugated, helical or annular, exterior with smooth interior and gasketed connectors.
      b. Corrugated, annular, with silt and watertight joints for storm sewers.

PART 3 - EXECUTION

3.01 PREPARATION

A. Excavate and backfill as specified in Section 31 2316 and 31 2323 with following additional requirements:
    1. Runs shall be as close as possible to those shown on Drawings.
    2. Excavate to required depth.
    3. Grade to obtain fall required.
    4. Remove debris from trench before laying bedding and pipe.
    5. Do not cut trenches near footings without consulting Architect.
    6. Backfill only after pipe lines have been tested, inspected, and approved by Architect.

3.02 INSTALLATION

A. Concrete Pipe:
    1. Unless specified otherwise concrete pipe shall be installed per American Concrete Pipe Association standards.
B. PVC / Polyethylene Pipe:
    1. Install in accordance with ASTM D 2321.
    2. Minimum cover for corrugated polyethylene pipe and fittings shall be 18 inches for H-20 load.
C. Use jacks to make-up gasketed joints.

3.03 FIELD QUALITY CONTROL

A. Water test shall be performed on pipes 8-inches in diameter or smaller.
B. Failure to install joints properly shall be cause for rejection and replacement of piping system.

3.04 CLEANING

A. Remove excess earth from site or place as directed by Architect.

END OF SECTION 33 4116