

PROJECT SPECIFICATIONS

700 SOUTH

Buildings 1 & 4

752 and 804 South 6200 West
Salt Lake City, Utah

Developed by: Property Reserve

**Butler Design Group, Inc.
5013 East Washington St. #100
Phoenix, Arizona 85034
(602) 957-1800**

BDG Project No.: 23052.100

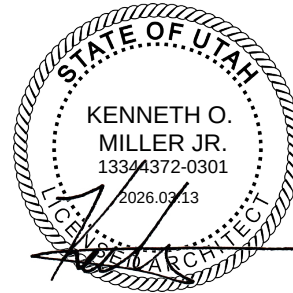
February 25, 2026

PROFESSIONAL REGISTRANT SEALS

A. ARCHITECTURAL

Licensed Architect Kenneth O. Miller

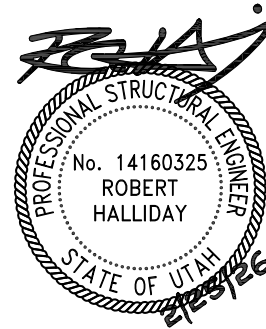
State of Utah Registration License Number 13344372-0301



B. STRUCTURAL

Licensed Engineer Robert Halliday

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C. MECHANICAL/PLUMBING

Licensed Engineer Michael J. Kraemer

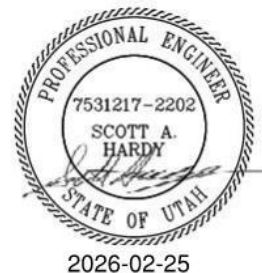
State of Utah Registration License Number 8175238-2202



D. ELECTRICAL

Licensed Engineer Scott A. Hardy

State of Utah Registration License Number 7531217-2202



E. GEOTECHNICAL

Licensed Engineer Alan Donald Spilker

State of Utah Registration License Number 334228



PROJECT MANUAL TABLE OF CONTENTS

DIVISION 00

DOCUMENT 00850	PROJECT DRAWING LIST	5
DOCUMENT 00880	SOILS REPORT	81

DIVISION 01

GENERAL REQUIREMENTS

SECTION 01 10 00	GENERAL REQUIREMENTS	9

DIVISION 02

EXISTING CONDITIONS

NONE USED

DIVISION 03

CONCRETE

SECTION 03 30 00	CAST-IN-PLACE CONCRETE	13
SECTION 03 47 00	SITE-CAST TILT-PANEL CONCRETE	9

DIVISION 04

MASONRY

NONE USED

DIVISION 05

METALS

SECTION 05 12 00	STRUCTURAL STEEL FRAMING	5
SECTION 05 21 00	STEEL JOISTS	4
SECTION 05 31 23	STEEL DECKING	3
SECTION 05 50 00	METAL FABRICATIONS	6
SECTION 05 51 10	STEEL STAIRS	4

DIVISION 06

WOOD AND PLASTICS

SECTION 06 10 50	ROUGH CARPENTRY	2

DIVISION 07

THERMAL AND MOISTURE PROTECTION

SECTION 07 11 10	BITUMINOUS DAMPPROOFING	2
SECTION 07 21 16	BUILDING INSULATION	3
SECTION 07 26 26	UNDER-SLAB VAPOR BARRIER	2
SECTION 07 42 13	COMPOSITE-METAL WALL PANELS	7
SECTION 07 46 33	COMPOSITE CLAD SOFFIT PANELS	2
SECTION 07 54 23	TPO MEMBRANE ROOFING	5
SECTION 07 62 00	SHEET METAL FLASHING	3
SECTION 07 72 00	ROOF ACCESSORIES	3
SECTION 07 92 00	JOINT SEALERS	4

DIVISION 08

DOORS AND WINDOWS

SECTION 08 11 00	HOLLOW METAL DOORS AND FRAMES	4
SECTION 08 36 00	OVERHEAD SECTIONAL DOORS	5
SECTION 08 41 23	ALUMINUM-FRAMED ENTRANCES AND WINDOW WALLS	5
SECTION 08 62 13	UNIT SKYLIGHTS	3
SECTION 08 71 00	DOOR HARDWARE	6
SECTION 08 81 00	GLASS and GLAZING	6

DIVISION 09

FINISHES

SECTION 09 29 00	GYPSUM BOARD	3
SECTION 09 91 13	PAINTING	8

DIVISION 10

SPECIALTIES

SECTION 10 14 00	TRAFFIC CONTROL SIGNS	2

DIVISION 11

EQUIPMENT

SECTION 11 16 10	LOADING DOCK EQUIPMENT	6

DIVISION 12

FURNISHINGS

NONE USED

DIVISION 13	SPECIAL CONSTRUCTION	
NONE USED		
DIVISION 14	CONVEYING EQUIPMENT	
NONE USED		
DIVISION 21	FIRE SUPPRESSION	
SECTION 21 13 13	WET-PIPE SPRINKLER SYSTEMS.....	18
DIVISION 22	PLUMBING	
SECTION 22 01 00	GENERAL PLUMBING REQUIREMENTS	11
SECTION 22 01 20	TRENCHING & BACKFILL for PLUMBING SYSTEMS	2
SECTION 22 05 21	VALVES and SPECIALTIES	2
SECTION 22 07 21	PLUMBING INSULATION	2
SECTION 22 11 00	BUILDING WATER SUPPLY SYSTEM.....	4
SECTION 22 11 23	BUILDING NATURAL GAS SUPPLY SYSTEM	3
SECTION 22 13 00	BUILDING SOIL and WASTE SYSTEM.....	4
SECTION 22 14 00	BUILDING ROOF DRAINAGE SYSTEM.....	2
DIVISION 23	HEATING, VENTILATION AND AIR-CONDITIONING	
SECTION 23 01 00	GENERAL MECHANICAL REQUIREMENTS.....	13
SECTION 23 01 20	TRENCHING & BACKFILL for MECHANICAL SYSTEMS.....	2
SECTION 23 05 19	PIPING SPECIALTIES	6
SECTION 23 05 23	VALVES	4
SECTION 23 05 48	VIBRATION ISOLATION of MECHANICAL SYSTEMS	3
SECTION 23 05 93	TESTING & BALANCING of MECHANICAL SYSTEMS.....	9
SECTION 23 07 00	MECHANICAL SYSTEMS INSULATION	4
SECTION 23 20 00	PIPE & PIPE FITTINGS	7
SECTION 23 23 00	REFRIGERANT PIPING	3
SECTION 23 30 00	AIR TEMPERING	11
DIVISION 24	SPECIAL CONSTRUCTION	
NONE USED		
DIVISION 25	INTEGRATED AUTOMATION	
NONE USED		
DIVISION 26	ELECTRICAL	
SECTION 26 00 01	ELECTRICAL GENERAL PROVISIONS.....	10
SECTION 26 05 19	LOW VOLTAGE POWER CONDUCTORS	8
SECTION 26 05 26	GROUNDING & BONDING	8
SECTION 26 05 29	HANGERS & SUPPORTS.....	5
SECTION 26 05 33.13	CONDUITS	14
SECTION 26 05 33.16	RACEWAY & BOXES.....	5
SECTION 26 05 48.16	SEISMIC CONTROLS	7
SECTION 26 05 53	IDENTIFICATION for ELECTRICAL SYSTEMS	8
SECTION 26 06 73	PROTECTIVE DEVICE STUDY	8
SECTION 26 09 23	LIGHTING CONTROL DEVICES	6
SECTION 26 09 43.23	RELAY-BASED LIGHTING CONTROLS	5
SECTION 26 22 13	LOW-VOLTAGE TRANSFORMERS	7
SECTION 26 24 13	SWITCHBOARDS	9
SECTION 26 24 16	PANELBOARDS.....	8
SECTION 26 25 53.11	ELECTRIC VEHICLE SERVICE EQUIPMENT – LEVEL 2.....	7
SECTION 26 27 13	ELECTRICITY METERING	6
SECTION 26 27 26	WIRING DEVICES.....	5
SECTION 26 28 13	FUSES.....	2
SECTION 26 28 16	ENCLOSED SWITCHES & CIRCUIT BREAKERS	7
SECTION 26 19 13	MOTOR CONTROLLERS	11
SECTION 26 43 13	SURGE PROTECTION LOW-VOLTAGE CIRCUITS.....	4
SECTION 26 51 19	LED INTERIOR LIGHTING	6
SECTION 26 56 13	LIGHTING POLES & STANDARDS	5
SECTION 26 56 19	LED EXTERIOR LIGHTING	6

DIVISION 27	COMMUNICATION SYSTEMS	
SECTION 27 05 26.22	GROUNDING & BONDING for COMMUNICATION SYSTEMS	7
SECTION 27 05 28.22	PATHWAYS for COMMUNICATION SYSTEMS	10
DIVISION 28	ELECTRONIC SAFETY AND SECURITY	
SECTION 28 46 24.11	ADDRESSABLE FIRE-ALARM SYSTEM	18
DIVISION 31	EARTHWORK	
SECTION 31 20 00	EARTHWORK	8
SECTION 31 31 20	SOIL TREATMENT	3
DIVISION 32	EXTERIOR IMPROVEMENTS	
SECTION 32 12 16	ASPHALT PAVEMENT	4
SECTION 32 13 13	SITE CONCRETE PAVING	6
SECTION 32 17 23	TRAFFIC MARKING PAINT	2
SECTION 32 31 19	ORNAMENTAL METAL FENCING & GATES	5
SECTION 32 84 00	LANDSCAPE IRRIGATION	SEE DRAWINGS
SECTION 32 93 00	LANDSCAPE PLANTING	SEE DRAWINGS
DIVISION 33	UTILITIES	
NONE USED		

END OF TABLE OF CONTENTS

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CONTRACT DRAWING LIST

1.0 PROJECT DRAWINGS INDEX – BUILDING 1

A. ARCHITECTURAL

G000	COVER SHEET
G001	PROJECT DATA & SHEET INDEX
G111	EXIT EGRESS PLAN
A000	OVERALL SITE PLAN
A001	ENLARGED SITE PLAN
A011	HARDSCAPE SITE PLANS
A015	ENLARGED DRIVE-IN RAMP PLANS
A021	SITE DETAILS
A022	SITE DETAILS
A023	SITE DETAILS
A024	SITE DETAILS
A110	OVERALL FLOOR PLAN
A111	PARTIAL FLOOR PLAN
A112	PARTIAL FLOOR PLAN
A113	PARTIAL PLUMBING FLOOR PLAN
A114	REFLECTED CEILING PLAN
A120	ROOF PLAN
A121	CANOPY PLANS
A310	OVERALL EXTERIOR BUILDING ELEVATIONS
A311	ENLARGED PARTIAL ELEVATIONS
A312	ENLARGED PARTIAL ELEVATIONS
A313	ENLARGED PARTIAL ELEVATIONS
A314	ENLARGED PARTIAL ELEVATIONS
A410	OVERALL BUILDING SECTIONS
A411	WALL SECTIONS
A412	WALL SECTIONS
A413	WALL SECTIONS
A501	DOOR TYPES & WINDOW SCHEDULES
A511	WINDOW TYPES
A521	WINDOW DETAILS
A601	ARCHITECTURAL DETAILS
A611	ROOF DETAILS
A711	STAIR DETAILS

B. STRUCTURAL

S001	GENERAL STRUCTURAL NOTES
S002	GENERAL STRUCTURAL NOTES
S003	GENERAL STRUCTURAL NOTES
S004	GENERAL STRUCTURAL NOTES
S005	WIND PRESSURE COMPONENTS
S006	SCHEDULES
S111	PARTIAL FOUNDATION PLAN
S112	PARTIAL FOUNDATION PLAN
S211	PARTIAL ROOF FRAMING PLAN
S212	PARTIAL ROOF FRAMING PLAN
S213	CANOPY FRAMING PLAN
S301	PANEL ELEVATIONS
S302	PANEL ELEVATIONS
S303	PANEL TYPE ELEVATIONS
S304	PANEL TYPE ELEVATIONS
S305	PANEL TYPE ELEVATIONS
S401	TYPICAL DETAILS
S402	TYPICAL DETAILS
S403	TYPICAL DETAILS
S501	FOUNDATION DETAILS
S502	FOUNDATION DETAILS
S503	FOUNDATION DETAILS
S504	FOUNDATION DETAILS
S601	TILT PANEL DETAILS
S602	TILT PANEL DETAILS
S701	FRAMING DETAILS

S702 FRAMING DETAILS
S703 FRAMING DETAILS
S704 FRAMING DETAILS
S705 FRAMING DETAILS

C. MECHANICAL

M001 MECHANICAL SYMBOLS
M002 MECHANICAL SCHEDULES
M003 MECHANICAL SCHEDULES
M100 OVERALL MECHANICAL FLOOR PLAN
M101 FIRE PUMP ROOM MECHANICAL FLOOR PLAN
M201 MECHANICAL DETAILS

D. PLUMBING

P001 PLUMBING COVER SHEET
P002 PLUMBING SPECIFICATIONS & WATER CALCS
P003 PLUMBING DETAILS
P111 OVERALL PLUMBING FLOOR PLAN
P211 ENLARGED PLUMBING FLOOR PLAN
P400 NATURAL GAS ISOMETRICS

E. ELECTRICAL

EG011 GENERAL NOTES & SYMBOLS LISTS
EG012 SYMBOLS LISTS
ES110 ELECTRICAL SITE PLAN
ES111 ELECTRICAL SITE LIGHTING PLAN
ES511 SITE ELECTRICAL DETAILS
ES512 STREET LIGHT DETAILS
ES513 STREET LIGHT DETAILS
EL111 ELECTRICAL LIGHTING FLOOR PLAN – AREA A
EL112 ELECTRICAL LIGHTING FLOOR PLAN – AREA B
EL511 ELECTRICAL LIGHTING DETAILS
EL611 LIGHT FIXTURE SCHEDULES
EP111 ELECTRICAL FLOOR PLAN – AREA A
EP112 ELECTRICAL FLOOR PLAN – AREA B
EP511 ELECTRICAL DETAILS
EP512 ELECTRICAL DETAILS
EP611 ELECTRICAL SCHEDULES
EP711 SES ONE- LINE DIAGRAM
EP713 PANEL METERING DIAGRAMS
EP811 PANEL SCHEDULES
EP812 PANEL SCHEDULES
EP813 PANEL SCHEDULES
EY111 SPECIAL SYSTEMS FLOOR PLAN – AREA A
EY112 SPECIAL SYSTEMS FLOOR PLAN – AREA B
EY511 SPECIAL SYSTEMS DETAILS
EY711 FIRE RISER DIAGRAM & ALARM SYSTEMS

F. CIVIL

CV COVER SHEET
GN GENERAL NOTES
C1.0 SITE PLAN
C2.0 GRADING PLAN
C2.1 DRAINAGE PLAN
C3.0 UTILITY PLAN
C4.1 DETAILS
C4.2 DETAILS
C4.3 DETAILS
C5.0 SWPPP PLAN
C5.1 SWPPP DETAILS

G. LANDSCAPE

LA.01 LANDSCAPE COVER SHEET
LA.02 LANDSCAPE PLAN
LA.03 LANDSCAPE PLAN
LA.04 IRRIGATION PLAN
LA.05 IRRIGATION PLAN
LA.06 LANDSCAPE DETAILS
LA.07 IRRIGATION DETAILS

2.0 PROJECT DRAWINGS INDEX – BUILDING 4

- A. ARCHITECTURAL
- G000 COVER SHEET
 - G001 PROJECT DATA & SHEET INDEX
 - G111 EXIT EGRESS PLAN
 - A000 OVERALL SITE PLAN
 - A001 ENLARGED SITE PLAN
 - A011 HARDSCAPE SITE PLANS
 - A015 ENLARGED DRIVE-IN RAMP PLANS
 - A021 SITE DETAILS
 - A022 SITE DETAILS
 - A023 SITE DETAILS
 - A024 SITE DETAILS
 - A110 OVERALL FLOOR PLAN
 - A111 PARTIAL FLOOR PLAN
 - A112 PARTIAL FLOOR PLAN
 - A113 PARTIAL PLUMBING FLOOR PLAN
 - A114 REFLECTED CEILING PLAN
 - A120 ROOF PLAN
 - A121 CANOPY PLANS
 - A310 OVERALL EXTERIOR BUILDING ELEVATIONS
 - A311 ENLARGED PARTIAL ELEVATIONS
 - A312 ENLARGED PARTIAL ELEVATIONS
 - A313 ENLARGED PARTIAL ELEVATIONS
 - A410 OVERALL BUILDING SECTIONS
 - A411 WALL SECTIONS
 - A412 WALL SECTIONS
 - A413 WALL SECTIONS
 - A501 DOOR TYPES & WINDOW SCHEDULES
 - A511 WINDOW TYPES
 - A521 WINDOW DETAILS
 - A601 ARCHITECTURAL DETAILS
 - A611 ROOF DETAILS
 - A612 CANOPY DETAILS
 - A711 STAIR DETAILS
- B. STRUCTURAL
- S001 GENERAL STRUCTURAL NOTES
 - S002 GENERAL STRUCTURAL NOTES
 - S003 GENERAL STRUCTURAL NOTES
 - S004 GENERAL STRUCTURAL NOTES
 - S005 WIND PRESSURE COMPONENTS
 - S006 SCHEDULES
 - S111 PARTIAL FOUNDATION PLAN
 - S112 PARTIAL FOUNDATION PLAN
 - S113 PARTIAL FOUNDATION PLAN
 - S211 PARTIAL ROOF FRAMING PLAN
 - S212 PARTIAL ROOF FRAMING PLAN
 - S213 PARTIAL ROOF FRAMING PLAN
 - S214 CANOPY FRAMING PLAN
 - S301 PANEL ELEVATIONS
 - S302 PANEL ELEVATIONS
 - S303 PANEL TYPE ELEVATIONS
 - S304 PANEL TYPE ELEVATIONS
 - S305 PANEL TYPE ELEVATIONS
 - S306 PANEL TYPE ELEVATIONS
 - S401 TYPICAL DETAILS
 - S402 TYPICAL DETAILS
 - S403 TYPICAL DETAILS
 - S501 FOUNDATION DETAILS
 - S502 FOUNDATION DETAILS
 - S503 FOUNDATION DETAILS
 - S601 TILT PANEL DETAILS
 - S602 TILT PANEL DETAILS
 - S701 FRAMING DETAILS

S702 FRAMING DETAILS
S703 FRAMING DETAILS
S704 FRAMING DETAILS
S705 FRAMING DETAILS

C. MECHANICAL

M001 MECHANICAL SYMBOLS
M002 MECHANICAL SCHEDULES
M003 MECHANICAL SCHEDULES
M100 OVERALL MECHANICAL FLOOR PLAN
M101 FIRE PUMP ROOM MECHANICAL FLOOR PLAN
M201 MECHANICAL DETAILS

D. PLUMBING

P001 PLUMBING COVER SHEET
P002 PLUMBING SPECIFICATIONS & WATER CALCS
P003 PLUMBING DETAILS
P111 OVERALL PLUMBING FLOOR PLAN
P211 ENLARGED PLUMBING FLOOR PLAN
P400 NATURAL GAS ISOMETRICS

E. ELECTRICAL

EG201 GENERAL NOTES & SYMBOLS LISTS
EG202 SYMBOLS LISTS
EP201A ELECTRICAL FLOOR PLAN
EP201B ELECTRICAL FLOOR PLAN
EP202A ELECTRICAL CEILING PLAN
EP202B ELECTRICAL CEILING PLAN
EP421 ELEVATION VIEWS
EP501 ELECTRICAL DETAILS
EP502 ELECTRICAL DETAILS
EP503 ELECTRICAL DETAILS
EP602 LIGHT FIXTURE SCHEDULES
EP621 ELECTRICAL SCHEDULES
EP703 FIRE RISER DIAGRAM & ALLARM SYSTEMS
EP721 SES ONE- LINE DIAGRAM
EP722 PANEL METERING DIAGRAMS
EP821 PANEL SCHEDULES
EP822 PANEL SCHEDULES
EP823 PANEL SCHEDULES
ES101 ELECTRICAL SITE PLAN
ES102 ELECTRICAL SITE LIGHTING PLAN
ES401 SITE ENLARGED PLANS
ES501 SITE ELECTRICAL DETAILS
ES502 SITE ELECTRICAL DETAILS

F. CIVIL

CV COVER SHEET
GN GENERAL NOTES
C1.0 OVERALL SITE PLAN
C1.1 SITE PLAN
C1.2 SITE PLAN
C2.0 OVERALL GRADING & DRAINAGE PLAN
C2.1 GRADING PLAN
C2.2 GRADING PLAN
C2.3 DRAINAGE PLAN
C2.4 DRAINAGE PLAN
C3.0 UTILITY PLAN
C3.1 UTILITY PLAN
C3.2 UTILITY PLAN
C4.1 DETAILS
C4.2 DETAILS
C4.3 DETAILS
C5.0 SWPPP PLAN
C5.1 SWPPP DETAILS

G. LANDSCAPE

LA.01 LANDSCAPE COVER SHEET
LA.02 LANDSCAPE PLAN

LA.03	LANDSCAPE PLAN
LA.04	IRRIGATION PLAN
LA.05	IRRIGATION PLAN
LA.06	LANDSCAPE DETAILS
LA.07	IRRIGATION DETAILS
LA.08	SPECIFICATIONS

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SOILS INVESTIGATION DATA

1.0 SOILS REPORT

1.1 INVESTIGATION

- A. A soil and subsurface investigation was conducted at the site, the results of which is to be found in the Project Soils Report No. 3994-001-24 prepared by GSH Geotechnical, dated October 16, 2024. A copy of the report, and addenda, is attached.

1.2 INTERPRETATION

- A. Soil investigation data is provided as part of the Contract Documents and shall be relied upon to the extent of the information given in the report. Contractor is urged to examine the report and the site and determine the character of materials and conditions to be encountered in the performance of the Work. Owner and Architect disclaim any responsibility for interpretation of data within the report by the Contractor.

END OF DOCUMENT

**REPORT
GEOTECHNICAL STUDY
PROPOSED 700 SOUTH PSP OFFICE/WAREHOUSE
DISTRIBUTION FACILITY – BUILDINGS 1 AND 2
SOUTHEAST CORNER OF 700 SOUTH 6400 WEST
SALT LAKE CITY, UTAH**

Submitted To:

Property Reserve
51 South Main, Suite 301
Salt Lake City, Utah 84111

Submitted By:

GSH Geotechnical, Inc.
473 West 4800 South
Salt Lake City, Utah 84123

October 16, 2024

Job No. 3994-001-24

October 16, 2024
Job No. 3994-001-24

Ms. Mary Cunningham
Property Reserve
51 South Main, Suite 301
Salt Lake City, Utah 84111

Ms. Cunningham:

Re: Report
Geotechnical Study
Proposed 700 South PSP Office/Warehouse Distribution Facility – Buildings 1 and 2
Southeast Corner of 700 South 6400 West Street
Salt Lake City, Utah

1. INTRODUCTION

1.1 GENERAL

This report presents the results of our geotechnical study performed at the site of the proposed office/warehouse/distribution facility to be located at the southeast corner of 700 South and 6400 West Street in Salt Lake City, Utah. The general location of the site with respect to existing roadways, as of 2024, is presented on Figure 1, Vicinity Map. A more detailed layout of the site showing proposed facilities, existing roadways, and the borings drilled in conjunction with this study is presented on Figure 2, Site Plan.

This report has been completed as a design level geotechnical study for Buildings 1 and 2 of the development. This report is also intended to provide preliminary recommendations for Buildings 3, 4, and 5. A design level geotechnical study, including additional subsurface investigation, is required for Building 3, 4, and 5.

1.2 OBJECTIVES AND SCOPE

The objectives and scope of the study were planned in discussions between Ms. Mary Cunningham of Property Reserve and Mr. Robert Gifford of GSH Geotechnical, Inc. (GSH).

In general, the objectives of this study were to:

1. Define and evaluate the subsurface soil and groundwater conditions across the site.
2. Provide appropriate foundation, earthwork, pavement, stormwater percolation, and geoseismic recommendations to be utilized in the design and construction of the proposed facilities.

In accomplishing these objectives, our scope has included the following:

1. A field program consisting of the exploration, logging, and sampling of 30 borings, as well as performing a stormwater percolation test.
2. A laboratory testing program.
3. An office program consisting of the correlation of available data, engineering analysis, and the preparation of this summary report.

1.3 AUTHORIZATION

Authorization was provided by returning a signed copy of the Professional Services Agreement No. 24-0925 dated September 13, 2024.

1.4 PROFESSIONAL STATEMENTS

Supporting data upon which our recommendations are based are presented in subsequent sections of this report. Recommendations presented herein are governed by the physical properties of the soils encountered in the exploration borings, projected groundwater conditions, and the layout and design data discussed in Section 2, Proposed Construction. If subsurface conditions other than those described in this report are encountered and/or if design and layout changes are implemented, GSH must be informed so that our recommendations can be reviewed and amended, if necessary.

Our professional services have been performed, our findings developed, and our recommendations prepared in accordance with generally accepted engineering principles and practices in this area at this time.

This report has been completed as a design level geotechnical study for Buildings 1 and 2 of the development. This report is also intended to provide preliminary recommendations for Buildings 3, 4, and 5. A design level geotechnical study, including additional subsurface investigation, is required for Buildings 3, 4, and 5.

2. PROPOSED CONSTRUCTION

The approximately 70-acre site is proposed to be developed for the construction of five office/warehouse structures, adjoining pavements, and a new public roadway. The structures are anticipated to be 1- to 2-levels, established slab-on-grade, and have footprints ranging from approximately 88,000 to 235,800 square feet. The structures are anticipated to be constructed with tilt-up concrete construction and be supported upon conventional spread and continuous wall foundations.

Maximum real column and wall loads are anticipated to be on the order of up to 220 kips and 5 to 6 kips per lineal foot, respectively. Real loads are defined as the total of all dead plus frequently applied (reduced) live loads.

GSH understands that the proposed section of new public roadway intersecting the site is to be designed by the Utah Department of Transportation.

Paved parking areas, drive lanes, and loading/unloading areas are planned around the structures. Projected traffic in the parking areas and light-duty drive lanes is anticipated to consist of a light volume of automobiles and light trucks, occasional medium-weight trucks, and no heavyweight trucks. Projected traffic in the loading/unloading areas and heavy-duty drive lanes is anticipated to consist of a moderate volume of automobiles, light trucks, and medium-weight trucks with a light volume of heavyweight trucks.

Site development will require some earthwork in the form of minor cutting and filling. At this time, we anticipate that maximum site grading cuts and fills, excluding utilities, will be on the order of 2 to 5 feet.

3. SITE INVESTIGATIONS

3.1 GENERAL

Subsurface conditions in unexplored locations or at other times may vary from those encountered at specific boring locations. If such variations are noted during construction or if project development plans are changed, GSH must review the changes and amend our recommendations, if necessary.

Boring locations were established by estimating distances and angles from site landmarks. If increased accuracy is desired by the client, we recommend that the boring locations and elevations be surveyed.

3.2 FIELD PROGRAM

To define and evaluate the subsurface soil and groundwater conditions across the site, 30 borings were completed within the accessible areas. These borings were completed to depths ranging from 5.5 to 40.0 feet with a truck-mounted drill rig equipped with hollow-stem augers. Heaving sand

soils terminated Boring B-12. The approximate locations of the borings are presented on Figure 2. Additionally, a stormwater percolation test to determine the percolation rate was performed in Boring B-16 at a depth of 5.0 feet.

The field portion of our study was under the direct control and continual supervision of an experienced member of our geotechnical staff. During the course of the drilling operations, a continuous log of the subsurface conditions encountered was maintained. In addition, samples of the typical soils encountered were obtained for subsequent laboratory testing and examination. The soils were classified in the field based upon visual and textural examination. These classifications were supplemented by subsequent inspection and testing in our laboratory. Graphical representation of the subsurface conditions encountered is presented on Figures 3A through 3AD, Boring Logs. Soils were classified in accordance with the nomenclature described on Figure 4, Key to Boring Log (USCS).

A 3.25-inch outside diameter, 2.42-inch inside diameter (Dames & Moore) and a 2.0-inch outside diameter, 1.38-inch inside diameter drive sampler (SPT) were utilized at select locations and depths. The blow counts recorded on the boring logs were those required to drive the sampler 12 inches with a 140-pound hammer dropping 30 inches.

Following completion of exploration operations, 1.25-inch diameter slotted PVC pipe was installed in Borings B-1, B-10, B-11, B-15, B-24, B-25, B-28, and B-30 to provide a means of monitoring the groundwater fluctuations. The borings were backfilled with auger cuttings.

3.3 LABORATORY TESTING

3.3.1 General

To provide data necessary for our engineering analysis, a laboratory testing program was performed. This program included moisture, density, partial gradation, Atterberg limits, consolidation, laboratory vane shear, and chemical tests. The following paragraphs describe the tests and summarize the test data.

3.3.2 Moisture and Density Tests

To provide index parameters and to correlate other test data, moisture and density tests were performed on selected samples. The results of these tests are presented on the boring logs, Figures 3A through 3AD.

3.3.3 Partial Gradation Tests

To aid in classifying the granular soils, partial gradation tests were performed. Results of the tests are tabulated on the following page and presented on the boring logs, Figures 3A through 3AD.

Boring No.	Depth (feet)	Percent Passing No. 200 Sieve	Moisture Content Percent	Soil Classification
B-8	15.0	31.7	25.6	SM
B-9	10.0	75.6	26.5	SM*
B-10	15.0	4.9	27.6	SP
B-12	15.0	31.6	25.2	SM*
B-12	20.0	10.8	32.1	SP/SM*
B-12	15.0	7.3	20.4	SP/SM
B-12	35.0	7.1	21.7	SP/SM*
B-13	10.0	41.8	25.5	SM/SC
B-14	10.0	22.2	30.8	SM/SC
B-24	2.5	90.9	24.2	CL^
B-29	15.0	61.1	28.8	SM/SC*
B-30	5.0	40.3	18.1	SM/SC

* Sample contained layers of clay

^ Sample contained layers of sand

3.3.4 Atterberg Limits Test

To aid in classifying the soils, Atterberg limits tests are being performed on samples of the fine-grained cohesive soils. Results of the tests will be transmitted to you upon completion.

3.3.5 Consolidation Tests

To provide data necessary for our settlement analysis, consolidation testing was performed on 7 representative samples of the natural fine-grained clay soils encountered at the site. The results of these tests indicate that the samples tested were moderately over-consolidated and will exhibit moderate strength and compressibility characteristics under the anticipated loading. Detailed results of the tests are maintained within our files and can be transmitted to you, upon your request.

3.3.6 Laboratory Vane Shear Tests

To determine the undrained shear strength of the clay soils encountered at the site, laboratory vane shear tests are being performed. The results of the tests will be transmitted to you upon completion.

3.3.7 Chemical Tests

A representative soil sample was collected and sent for laboratory analysis for pH and sulfate content. As of the date of this report, results are still pending and will be transmitted when available and with corresponding cement recommendations, if applicable.

4. SITE CONDITIONS

4.1 SURFACE

The site is located at the southeast corner of 700 South Street and 6400 West Street in Salt Lake City, Utah. The site is currently vacant/undeveloped land. The topography of the site is relatively flat, grading down to the west with a total relief of approximately 10 to 12 feet. Site vegetation consists of various weeds, brush, and grass.

The site is bounded to the north by 700 South Street followed by office/warehouse structures; to the east and west by office/warehouse structures; and to the south by railroad tracks followed by Salt Lake Valley Landfill.

4.2 SUBSURFACE SOIL

The following paragraphs provide generalized descriptions of the subsurface profiles and soil conditions encountered within the borings conducted during this study. As previously noted, soil conditions may vary in unexplored locations.

The borings were completed to depths ranging from 5.5 to 40.0 feet. The soil conditions encountered in each of the borings, to the depths completed, were generally similar across the boring locations.

- Approximately 6 inches of topsoil was encountered in each boring. Topsoil thickness is frequently erratic and thicker zones of topsoil should be anticipated.
- Non-engineered fill/disturbed soils were encountered in portions of the site, to depths ranging from 1.5 to 4.0 feet beneath the existing ground surface. The non-engineered fill/disturbed soils primarily consisted of clay with varying silt, sand, and gravel content and sand with varying clay and silt content.
- Natural soils were encountered below the non-engineered fill/disturbed soil or the ground surface in all boring locations. The natural soils consisted primarily of clay with varying silt and sand content and sand with varying clay, silt, and gravel content.
- Heaving sand soils causing auger refusal were encountered within Boring B-12 at a depth of approximately 40 feet below the existing ground surface.

The natural clay soils were soft to very stiff, slightly moist to saturated, brown, gray, tan, blue, and black in color, and moderately over-consolidated. The natural clay soils are anticipated to exhibit moderate strength and compressibility characteristics under the anticipated loading.

The natural sand soils were very loose to dense, moist to saturated, and gray, green, and brown in color. The natural sand soils are anticipated to exhibit moderately high strength and moderately low compressibility characteristics under the anticipated load range.

For a more descriptive interpretation of subsurface conditions, please refer to Figures 3A through 3AD, Boring Logs. The lines designating the interface between soil types on the boring logs generally represent approximate boundaries. In situ, the transition between soil types may be gradual.

4.3 GROUNDWATER

On October 15, 2024 (12 days following drilling), groundwater was measured within the PVC pipes installed as tabulated below:

Boring No.	Groundwater Depth (feet)
	October 15, 2024
B-1	0.4
B-10	0.6
B-11	4.0
B-15	9.3
B-24	2.0
B-25	3.8
B-28	6.7
B-30	6.3

Groundwater levels vary with changes in season and rainfall, construction activity, irrigation, snow melt, surface water run-off, and other site-specific factors.

5. DISCUSSIONS AND RECOMMENDATIONS

5.1 SUMMARY OF FINDINGS

The proposed structures may be supported upon conventional spread and continuous wall foundations supported upon suitable natural soils and/or structural fill extending to suitable natural

soils. Due to the very shallow depth to groundwater and the required replacement fill, GSH also evaluated utilizing soil improvement methods such as a grid of rammed-aggregate piers. Rammed-aggregate piers offer increased bearing, less earthwork, and no structural replacement fill.

The most significant geotechnical aspects at the site are:

1. The existing non-engineered fills/disturbed soils across much of the site.
2. The potential to encounter additional non-engineered fill/disturbed soils at the site.
3. The very shallow depth to groundwater.
4. The potentially liquefiable sand layers encountered in Borings B-8, B-9, B-12, B-14, and B-29.

Prior to proceeding with construction, removal of all debris, surface vegetation, root systems, topsoil, non-engineered fill/disturbed soil, and any deleterious materials from beneath an area extending out at least 5 feet from the perimeter of the proposed structure footprints and 3 feet beyond rigid pavements and exterior flatwork areas will be required. All existing utility locations should be reviewed to assess their impact on the proposed construction and abandoned and/or relocated as appropriate.

Due to the developed nature of this site and the surrounding area, additional non-engineered fills/disturbed soil may exist in unexplored areas of the site. Based on our experience, non-engineered fills are frequently erratic in composition and consistency. All surficial loose/disturbed soils and non-engineered fills must be removed below all footings, floor slabs, and rigid pavements. The in situ, non-engineered fills may remain below flexible pavements if free of any deleterious materials, of limited thickness, and if properly prepared, as discussed later in this report.

Some of the on-site non-engineered fill soils encountered were granular. On-site granular soils, including existing non-engineered fills, may be re-utilized as structural site grading fill if they meet the criteria for such, as stated later in this report.

Groundwater was measured as shallow as 0.4 feet below the ground surface. GSH recommends placing floor slabs no closer than 4 feet from the highest groundwater elevation. Site grading fill may be utilized to raise the overall grade to achieve the required separation between the floor slab and the highest groundwater elevation.

Proof rolling of the natural clay subgrade must not be completed if cuts extend to within 2 feet of the groundwater surface. In areas where cuts are to extend to within 2 feet of the groundwater surface, stabilization must be anticipated.

To reduce disturbance of the natural soils during excavation, it is recommended that low-impact, track-mounted equipment with smooth edge buckets/blades be utilized.

Very loose to medium dense, saturated sand layers were encountered in Borings B-8, B-9, B-12, B-14, and B-29. Due to liquefiable soils being present, the site has been determined to be Site Class F (in accordance with Section 20.3.1, Site Class F of ASCE 7-16). According to ASCE 7-16, a site-specific response analysis is required. Section 20.3.1 of ASCE 7-16 provides exception to this requirement under certain conditions. These options will need to be reviewed and evaluated by the project structural engineer. If needed, GSH can provide additional information and analysis, including a complete site-specific response analysis.

Detailed discussions pertaining to earthwork, foundations, pavements, and the geoseismic setting of the site are presented in the following sections.

5.2 EARTHWORK

5.2.1 Site Preparation

Initial site preparation will consist of the removal of all debris, non-engineered fills/disturbed soils, surface vegetation, root systems, topsoil, and any deleterious materials from beneath an area extending out at least 5 feet from the perimeter of the proposed structure footprint and 3 feet beyond rigid pavements and exterior flatwork areas. All existing utility locations should be reviewed to assess their impact on the proposed construction and abandoned and/or relocated as appropriate.

In situ, non-engineered fills may remain below flexible pavements if free of debris and deleterious materials, less than 3 feet in thickness, and if properly prepared. Proper preparation below pavements will consist of the scarification of the upper 12 inches below asphalt concrete (flexible pavement), followed by moisture preparation and re-compaction to the requirements of structural fill. Even with proper preparation, pavements established overlying non-engineered fills may encounter some long-term movements unless the non-engineered fills are completely removed.

It must be noted that from a handling and compaction standpoint, soils containing high amounts of fines (silts and clays) are inherently more difficult to rework and are very sensitive to changes in moisture content, requiring very close moisture control during placement and compaction. This will be very difficult, if not impossible, during wet and cold periods of the year. Additionally, the on-site soils are likely above optimum moisture content for compacting at present and would require some drying prior to re-compacting.

Subsequent to stripping and prior to the placement of floor slabs, foundations, structural site grading fills, exterior flatwork, and pavements, the exposed subgrade must be proof rolled by passing moderate-weight rubber tire-mounted construction equipment over the surface at least twice. If excessively soft or otherwise unsuitable soils are encountered beneath footings, they must be completely removed. If removal depth required is greater than 2 feet below footings, GSH must

be notified to provide further recommendations. In pavement, floor slab, and outside flatwork areas, unsuitable natural soils shall be removed to a maximum depth of 2 feet and replaced with compacted granular structural fill.

Subgrade preparation as described must be completed prior to placing overlying structural site grading fills.

Due to the relatively high groundwater, site grading cuts should be kept to a minimum. Cuts extending to within 2 feet of the groundwater elevation will likely disturb the natural clay soils and proof rolling must not be completed. Stabilization must be anticipated in areas where cuts are to extend to within 2 feet of the groundwater surface.

To reduce disturbance of the natural soils during excavation, it is recommended that low-impact, track-mounted equipment with smooth edge buckets/blades be utilized.

GSH must be notified prior to the placement of structural site grading fills, floor slabs, footings, and pavements to verify that all loose/disturbed soils and non-engineered fills have been completely removed and/or properly prepared.

5.2.2 Temporary Excavations

Temporary excavations up to 8 feet deep in fine-grained cohesive soils, above or below the water table, may be constructed with sideslopes no steeper than one-half horizontal to one vertical (0.5H:1.0V). Excavations deeper than 8 feet are not anticipated at the site.

For granular (cohesionless) soils, construction excavations above the water table, not exceeding 4 feet, shall be no steeper than one-half horizontal to one vertical (0.5H:1.0V). For excavations up to 8 feet, in granular soils and above the water table, the slopes shall be no steeper than one horizontal to one vertical (1H:1V). Excavations encountering saturated cohesionless soils will be very difficult and will require very flat sideslopes and/or shoring, bracing, and dewatering.

To reduce disturbance of the natural soils during excavation, it is recommended that low-impact, track-mounted equipment with smooth edge buckets/blades be utilized.

The static groundwater table was encountered as shallow as 0.4 feet below the existing surface and may be shallower with seasonal fluctuations. Consideration for dewatering of utility trenches, excavations for the removal of non-engineered fill, and other excavations below this level should be incorporated into the design and bidding process.

All excavations must be inspected periodically by qualified personnel. If any signs of instability or excessive sloughing are noted, immediate remedial action must be initiated.

5.2.3 Structural Fill

Structural fill is defined as all fill which will ultimately be subjected to structural loadings, such as imposed by footings, floor slabs, pavements, etc. Structural fill will be required as backfill over foundations and utilities, as site grading fill, and as replacement fill below footings. All structural fill must be free of surface vegetation, root systems, rubbish, topsoil, frozen soil, and other deleterious materials.

Structural site grading fill is defined as structural fill placed over relatively large open areas to raise the overall grade. For structural site grading fill, the maximum particle size shall not exceed 4 inches; although, occasional larger particles, not exceeding 8 inches in diameter, may be incorporated if placed randomly in a manner such that “honeycombing” does not occur, and the desired degree of compaction can be achieved. The maximum particle size within structural fill placed within confined areas shall be restricted to 2 inches.

On-site soils, including existing non-engineered fills, may be re-utilized as structural site grading fill if they do not contain construction debris or deleterious material and meet the requirements of structural fill. Fine-grained soils will require very close moisture control and may be very difficult, if not impossible, to properly place and compact during wet and cold periods of the year.

Imported structural fill below foundations and floor slabs shall consist of a well graded sand and gravel mixture with less than 30 percent retained on the three-quarter-inch sieve and less than 20 percent passing the No. 200 Sieve (clays and silts).

To stabilize soft subgrade conditions (if encountered) or where structural fill is required to be placed closer than 2.0 feet above the water table at the time of construction, a mixture of coarse angular gravels and cobbles and/or 1.5- to 2.0-inch gravel (stabilizing fill) shall be utilized. It may also help to utilize a stabilization fabric, such as Mirafi 600X or equivalent, placed on the natural ground if 1.5- to 2.0-inch gravel is used as stabilizing fill.

5.2.4 Fill Placement and Compaction

All structural fill shall be placed in lifts not exceeding 8 inches in loose thickness. Structural fills shall be compacted in accordance with the percent of the maximum dry density as determined by the AASHTO¹ T180 (ASTM² D1557) compaction criteria in accordance with the table on the following page.

¹ American Association of State Highway and Transportation Officials

² American Society for Testing and Materials

Location	Total Fill Thickness (feet)	Minimum Percentage of Maximum Dry Density
Beneath an area extending at least 5 feet beyond the perimeter of the structure	0 to 5	95
Site grading fills outside area defined above	0 to 5	90
Utility trenches within structural areas	--	96
Road base	--	96

Structural fills greater than 5 feet thick are not anticipated at the site.

Subsequent to stripping and prior to the placement of structural site grading fill, the subgrade shall be prepared as discussed in Section 5.2.1, Site Preparation, of this report. In confined areas, subgrade preparation shall consist of the removal of all loose or disturbed soils.

Coarse angular gravel and cobble mixtures (stabilizing fill), if utilized, shall be end dumped, spread to a maximum loose lift thickness of 15 inches, and compacted by dropping a backhoe bucket onto the surface continuously at least twice. As an alternative, the stabilizing fill may be compacted by passing moderately heavy construction equipment or large self-propelled compaction equipment over the surface at least twice. Subsequent fill material placed over the coarse gravels and cobbles shall be adequately compacted so that the “fines” are “worked into” the voids in the underlying coarser gravels and cobbles. Where soil fill materials are to be placed directly over more than about 18 inches of clean gravel, a separation geofabric, such as Mirafi 140N or equivalent, is recommended to be placed between the gravel and subsequent soil fills.

Non-structural fill may be placed in lifts not exceeding 12 inches in loose thickness and compacted by passing construction, spreading, or hauling equipment over the surface at least twice.

5.2.5 Utility Trenches

All utility trench backfill material below structurally loaded facilities (footings, floor slabs, flatwork, pavements, etc.) shall be placed at the same density requirements established for structural fill. If the surface of the backfill becomes disturbed during the course of construction, the backfill shall be proof rolled and/or properly compacted prior to the construction of any exterior flatwork over a backfilled trench. Proof rolling shall be performed by passing moderately loaded rubber tire-mounted construction equipment uniformly over the surface at least twice. If excessively loose or soft areas are encountered during proof rolling, they shall be removed to a maximum depth of 2 feet below design finish grade and replaced with structural fill.

Many utility companies and City-County governments are now requiring that Type A-1a or A-1b (AASHTO Designation – granular soils with limited fines) soils be used as backfill over utilities. These organizations are also requiring that in public roadways, the backfill over major utilities be compacted over the full depth of fill to at least 96 percent of the maximum dry density as determined by the AASHTO T180 (ASTM D1557) method of compaction. GSH recommends that as the major utilities continue onto the site that these compaction specifications are followed.

Fine-grained soils, such as silts and clays, are not recommended for utility trench backfill in structural areas.

The static groundwater table was encountered as shallow as 0.4 feet below the existing surface and may be shallower with seasonal fluctuations. Dewatering of utility trenches and other excavations below this level should be anticipated.

To reduce disturbance of the natural soils during excavation, it is recommended that low-impact, track-mounted equipment with smooth edge buckets/blades be utilized.

5.3 GROUNDWATER

On October 15, 2024 (12 days following drilling), groundwater was measured within the PVC pipes installed as tabulated below:

Boring No.	Groundwater Depth (feet)
	October 15, 2024
B-1	0.4
B-10	0.6
B-11	4.0
B-15	9.3
B-24	2.0
B-25	3.8
B-28	6.7
B-30	6.3

Based on the anticipated cuts necessary to reach design subgrades, we anticipate temporary dewatering, and significant stabilization will be necessary. Floor slabs must be placed a minimum of 4 feet from the stabilized groundwater elevation. Site grading fill may be utilized to raise the overall grade to achieve the required separation between the floor slab and the highest groundwater elevation.

The groundwater measurements presented are conditions at the time of the field exploration and may not be representative of other times or locations. Groundwater levels may vary seasonally and with precipitation, as well as other factors including irrigation. Evaluation of these factors is beyond the scope of this study. Groundwater levels may, therefore, be at shallower or deeper depths than those measured during this study, including during construction and over the life of the structure.

The extent and nature of any dewatering required during construction will be dependent on the actual groundwater conditions prevalent at the time of construction and the effectiveness of construction drainage to prevent run-off into open excavations.

5.3.1 Stormwater Percolation Test

A stormwater percolation test was performed at a depth of approximately 5 feet in the representative natural clay soils at Boring B-16. The field percolation rate was 60 minutes per inch. This design percolation rate should be considered typical for the soils at the site.

Groundwater was not encountered within Boring B-16 at the time of the percolation test. However, it should be noted that groundwater was encountered at depths between 0.4 and 9.3 feet below the ground surface. The shallow depth of groundwater should be accounted for in final design of stormwater system.

5.4 SPREAD AND CONTINUOUS WALL FOUNDATIONS

5.4.1 Design Data

The results of our analysis indicate that the proposed structures may be supported upon conventional spread and continuous wall foundations established upon suitable natural soils and/or structural fill extending to suitable natural soils. Under no circumstances shall foundations be established over non-engineered fills, loose or disturbed soils, topsoil, surface vegetation, root systems, rubbish, construction debris, other deleterious materials, frozen soils, or within ponded water. More heavily loaded footings will require a certain amount of granular structural replacement fill as specified in Section 5.4.3, Settlements, of this report. For design, the following parameters are provided:

Minimum Recommended Depth of Embedment for Frost Protection	- 30 inches
Minimum Recommended Depth of Embedment for Non-frost Conditions	- 15 inches
Recommended Minimum Width for Continuous Wall Footings	- 18 inches

Minimum Recommended Width for Isolated Spread Footings	- 24 inches
Recommended Net Bearing Capacity for Real Load Conditions	- 2,500 pounds per square foot
Bearing Capacity Increase for Seismic Loading	- 50 percent

The term “net bearing capacity” refers to the allowable pressure imposed by the portion of the structure located above lowest adjacent final grade. Therefore, the weight of the footing and backfill to lowest adjacent final grade need not be considered. Real loads are defined as the total of all dead plus frequently applied live loads. Total load includes all dead and live loads, including seismic and wind.

5.4.2 Installation

Under no circumstances shall the footings be installed upon non-engineered fills, loose or disturbed soils, topsoil, surface vegetation, root systems, rubbish, construction debris, or other deleterious materials. If unsuitable soils are encountered, they must be removed and replaced with compacted granular fill. If granular soils become loose or disturbed, they must be recompacted prior to pouring the concrete.

The width of structural replacement fill below footings shall be equal to the width of the footing plus one foot for each foot of fill thickness.

5.4.3 Settlements

Granular structural replacement fill will be required under more heavily loaded footings. For the required amount, refer to the table below:

Foundations	Loading	Minimum Thickness of Replacement Structural Granular Fill (feet)
Wall	Up to 6 kips per lineal foot	0
Spread	Up to 50 kips	0
	50 kips to 120 kips	1.5
	120 kips to 180 kips	2.5
	180 kips to 220 kips	3.5

Based on column loadings, soil bearing capacities, and the foundation recommendations as discussed above, we expect primary total settlement beneath individual foundations to be less than one inch.

The amount of differential settlement is difficult to predict because the subsurface and foundation loading conditions can vary considerably across the site. However, we anticipate differential settlement between adjacent foundations could vary from 0.5 to 0.75 inch. The final deflected shape of the structure will be dependent on actual foundation locations and loading.

5.5 SPREAD AND CONTINUOUS WALL FOUNDATIONS ESTABLISHED UPON RAMMED-AGGREGATE PIERS

5.5.1 General

Due to the very shallow depth to groundwater and the required replacement fill, GSH evaluated utilizing soil improvement methods such as a grid of rammed-aggregate piers. Rammed-aggregate piers offer increased bearing, less earthwork, and no structural replacement fill. Recommendations for rammed-aggregate piers are provided below.

5.5.2 Design Data

Rammed-aggregate piers soil reinforcement elements are constructed by drilling a 24- or 30-inch diameter hole and then building a bottom bulb of clean, open-graded stone using a beveled, high-energy tamper. The rammed-aggregate piers shaft is constructed on top of the bottom bulb using well graded highway base course stone placed in thin lifts (12 inches compacted thickness). The result is a reinforced zone of soil directly under footings that allows for the construction of shallow spread footings proportioned for a relatively high bearing pressure. Rammed-aggregate piers elements are spaced singly under continuous footings or in close groups to support concentrated column loads.

Rammed-aggregate piers soil reinforcement is a design/build element and must be designed and constructed by a licensed installer. The installer should provide layout and detailed design calculations sealed by a professional engineer licensed in the State of Utah. The design calculations should demonstrate that rammed-aggregate piers soil reinforcement is designed to control settlement to magnitudes within the criteria for this project.

For the design of conventional spread and continuous wall foundation constructed over rammed-aggregate piers elements, the parameters are provided below:

Minimum Recommended Depth of Embedment for Frost Protection	- 30 inches
Minimum Recommended Depth of Embedment for Non-frost Conditions	- 15 inches

Recommended Minimum Width for Continuous Wall Footings	- 16 inches
Minimum Recommended Width for Isolated Spread Footings	- 30 inches
Bearing Capacity for Footings Overlying Rammed-Aggregate Piers	- Approximately 4,000 to 6,000 pounds per square foot*

* To be developed as design build by rammed-aggregate piers licensed installer.

The term “net bearing capacity” refers to the allowable pressure imposed by the portion of the structure located above lowest adjacent final grade. Therefore, the weight of the footing and backfill to lowest adjacent final grade need not be considered. Real loads are defined as the total of all dead plus frequently applied live loads. Total load includes all dead and live loads, including seismic and wind.

5.5.3 Installation

Foundations must be established directly upon the undisturbed tops of the pier systems. It is recommended that prior to installing rammed-aggregate piers, all site grading activities be completed.

Unsuitable soils shall be completely removed beneath footings. Under no circumstances shall the footings be installed overlying organics, deleterious materials, frozen soil, or within ponded water.

5.5.4 Settlements

Maximum settlements of foundations designed and installed over rammed-aggregate piers should be less than one-half inch. However, these estimates will be refined with the design of the system.

5.6 LATERAL RESISTANCE

Lateral loads imposed upon foundations due to wind or seismic forces may be resisted by the development of passive earth pressures and friction between the base of the footings and the supporting soils. In determining frictional resistance, a coefficient of friction of 0.35 may be utilized for the footing interface with in situ natural clay soils and 0.40 for footing interface with natural granular soils or granular structural fill. Passive resistance provided by properly placed and compacted granular structural fill above the water table may be considered equivalent to a fluid with a density of 300 pounds per cubic foot. Below the water table, this granular soil shall be considered equivalent to a fluid with a density of 150 pounds per cubic foot.

A combination of passive earth resistance and friction may be utilized provided that the friction component of the total is divided by 1.5.

5.7 FLOOR SLABS

Floor slabs may be established upon suitable natural subgrade soils or structural fill extending to suitable natural soils. Under no circumstances shall floor slabs be established directly over non-engineered fills, loose or disturbed soils, sod, rubbish, construction debris, other deleterious materials, frozen soils, or within ponded water.

Additionally, GSH recommends that floor slabs be constructed a minimum of 4.0 feet from the stabilized groundwater elevation. Site grading fill may be utilized to raise the overall grade to achieve the required separation between the floor slab and the highest groundwater elevation.

To facilitate curing of the concrete and to provide a capillary moisture break, it is recommended that floor slabs be directly underlain by at least 4 inches of “free-draining” fill, such as “pea” gravel or three-quarters to one inch minus clean gap-graded gravel.

If a vapor barrier is proposed to be utilized, GSH must be contacted for additional recommendations.

Settlement of lightly loaded floor slabs designed according to previous recommendations (average uniform pressure of 200 pounds per square foot or less) is anticipated to be less than one-quarter of an inch.

5.8 PAVEMENTS

The natural clay soils and non-engineered fills/disturbed soil will exhibit poor pavement support characteristics when saturated. All pavement areas must be prepared as previously discussed (see Section 5.2.1, Site Preparation). Under no circumstances shall pavements be established over unprepared non-engineered fills, loose or disturbed soils, topsoil, surface vegetation, root systems, rubbish, construction debris, other deleterious materials, frozen soils, or within ponded water. With the subgrade soils and the estimated projected traffic as discussed in Section 2, Proposed Construction, the following pavement sections are recommended.

Parking Areas and Light-Duty Drive Lanes

(Light Volume of Automobiles and Light Trucks,
 Occasional Medium-Weight Trucks,
 and No Heavyweight Trucks)
 [6 equivalent 18-kip axle loads per day]

Flexible Pavements:
 (Asphalt Concrete)

3.0 inches	Asphalt concrete
8.0 inches	Aggregate base
Over	Properly prepared and stabilized fills, natural subgrade soils, and/or structural site grading fill extending to properly prepared and stabilized fills and/or natural subgrade soils

Rigid Pavements:
 (Non-reinforced Concrete)

5.0 inches	Portland cement concrete (non-reinforced)
5.0 inches	Aggregate base
Over	Properly prepared and stabilized natural subgrade soils, and/or structural site grading fill extending to properly prepared and stabilized natural subgrade soils

Loading/Unloading Areas and Heavy-Duty Drive Lanes

(Moderate Volume of Automobiles, Light Trucks,
 and Medium-Weight Trucks,
 with a Light Volume of Heavyweight Trucks)
 [39 equivalent 18-kip axle loads per day]

Flexible Pavements:
 (Asphalt Concrete)

4.0 inches	Asphalt concrete
8.0 inches	Aggregate base
8.0 inches*	Aggregate subbase
Over	Properly prepared and stabilized fills, natural subgrade soils, and/or structural site grading fill extending to properly prepared and stabilized fills and/or natural subgrade soils

* Subbase may consist of granular site grading fills with a minimum California Bearing Ratio (CBR) of 30 percent.

Rigid Pavements:
 (Non-reinforced Concrete)

6.0 inches	Portland cement concrete (non-reinforced)
6.0 inches	Aggregate base
Over	Properly prepared and stabilized natural subgrade soils, and/or structural site grading fill extending to properly prepared and stabilized natural subgrade soils

For dumpster pads, we recommend a pavement section consisting of 8.0 inches of Portland cement concrete, 12.0 inches of aggregate base, over properly prepared natural subgrade or site grading structural fills. Dumpster pads shall not be constructed overlying non-engineered fills under any circumstances.

These above rigid pavement sections are for non-reinforced Portland cement concrete. Concrete shall be designed in accordance with the American Concrete Institute (ACI) and joint details shall

conform to the Portland Cement Association (PCA) guidelines. The concrete shall have a minimum 28-day unconfined compressive strength of 4,000 pounds per square inch and contain 6 percent $\pm$ 1 percent air-entrainment.

The crushed stone shall conform to applicable sections of the current Utah Department of Transportation (UDOT) Standard Specifications. All asphalt material and paving operations shall meet applicable specifications of the Asphalt Institute and UDOT. A GSH technician shall observe placement and perform density testing of the base course material and asphalt.

Please note that the recommended pavement section is based on estimated post-construction traffic loading. If the pavement is to be constructed and utilized by construction traffic, the above pavement section may prove insufficient for heavy truck traffic, such as concrete trucks or tractor-trailers used for construction delivery. Unexpected distress, reduced pavement life, and/or premature failure of the pavement section could result if subjected to heavy construction traffic and the owner should be made aware of this risk. If the estimated traffic loading stated herein is not correct, GSH must review actual pavement loading conditions to determine if revisions to these recommendations are warranted.

5.9 CEMENT TYPES

A representative soil sample was collected and sent for laboratory analysis for pH and sulfate content. As of the date of this report, results are still pending and will be transmitted when available and with corresponding cement recommendations, if applicable.

5.10 GEOSEISMIC SETTING

5.10.1 General

Utah municipalities have adopted the International Building Code (IBC) 2021. The IBC 2021 code refers to ASCE 7-16 Minimum Design Loads and Associated Criteria for Buildings and Other Structures (ASCE 7-16) determines the seismic hazard for a site based upon mapping of bedrock accelerations prepared by the United States Geologic Survey (USGS) and the soil site class. The USGS values are presented on maps incorporated into the IBC code and are also available based on latitude and longitude coordinates (grid points).

5.10.2 Faulting

Based on our review of available literature, no active faults pass through or immediately adjacent to the site. The nearest active mapped fault consists of the Granger fault of the West Valley fault zone, located about 1.4 miles to the northeast of the site.

5.10.3 Site Class

Due to liquefiable soils being present, the site has been determined to be Site Class F (in accordance with Section 20.3.1, Site Class F of ASCE 7-16). According to ASCE 7-16, a site-specific response analysis is required. Section 20.3.1 of ASCE 7-16 provides exception to this requirement under certain conditions. These options will need to be reviewed and evaluated by the project structural engineer. If needed, GSH can provide additional information and analysis, including a complete site-specific response analysis.

5.10.4 Ground Motions

The IBC 2021 code is based on USGS mapping, which provides values of short and long period accelerations for average bedrock values for the Western United States and must be corrected for local soil conditions. The following table summarizes the peak ground and short and long period accelerations for the MCE event and incorporates the appropriate soil amplification factor for a Site Class F Soil Profile. Based on the site latitude and longitude (40.7528 degrees north and 112.0389 degrees west, respectively) and Risk Category II, the values for this site are tabulated below:

Spectral Acceleration Value, T	Bedrock Boundary [mapped values] (% g)	Site Coefficient	Site Class * [adjusted for site class effects] (% g)	Design Values* (% g)
Peak Ground Acceleration	*	$F_a = *$	*	*
0.2 Seconds (Short Period Acceleration)	$S_S = *$	$F_a = *$	$S_{MS} = *$	$S_{DS} = *$
1.0 Second (Long Period Acceleration)	$S_1 = *$	$F_v = *$	$S_{M1} = *$	$S_{D1} = *$

* See Section 5.10.3, Site Class.

5.10.5 Liquefaction

The site is located in an area that has been identified by the Utah Geological Survey (UGS) as being a “high” liquefaction potential zone. Liquefaction is defined as the condition when saturated, loose, granular soils lose their support capabilities because of excessive pore water pressure, which develops during a seismic event. Clayey soils, even if saturated, will generally not liquefy during a major seismic event.

Calculations were performed using the procedures described in the 2014 Soil Liquefaction During Earthquakes Monograph by Idriss and Boulanger³. Our calculations indicate the very loose to medium dense, saturated sand layers encountered in Borings B-8, B-9, B-12, B-14, B-29 could liquefy during the design seismic event. Calculated settlement associated with the liquefaction of each layer within the borings was less than 1.0 inch. This magnitude of settlement must be evaluated by the structural engineer to design for life safety. Additionally, lateral spread and ground rupture are unlikely to occur.

5.11 SITE VISITS

GSH must verify that all topsoil/disturbed soils and any other unsuitable soils have been removed, that non-engineered fills have been removed and/or properly prepared, and that suitable soils have been encountered prior to placing site grading fills, footings, slabs, and pavements. Additionally, GSH must observe fill placement and verify in-place moisture content and density of fill materials placed at the site.

6. CLOSURE

If you have any questions or would like to discuss these items further, please feel free to contact us at (801) 685-9190.

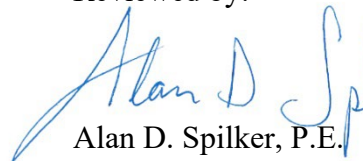
Respectfully submitted,

GSH Geotechnical, Inc.

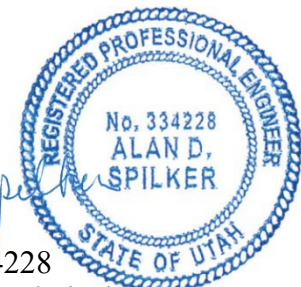


Giavanna Lonardo, E.I.T.
Staff Engineer

Reviewed by:



Alan D. Spilker, P.E.
State of Utah No. 334228
President/Senior Geotechnical Engineer

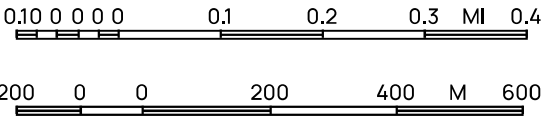
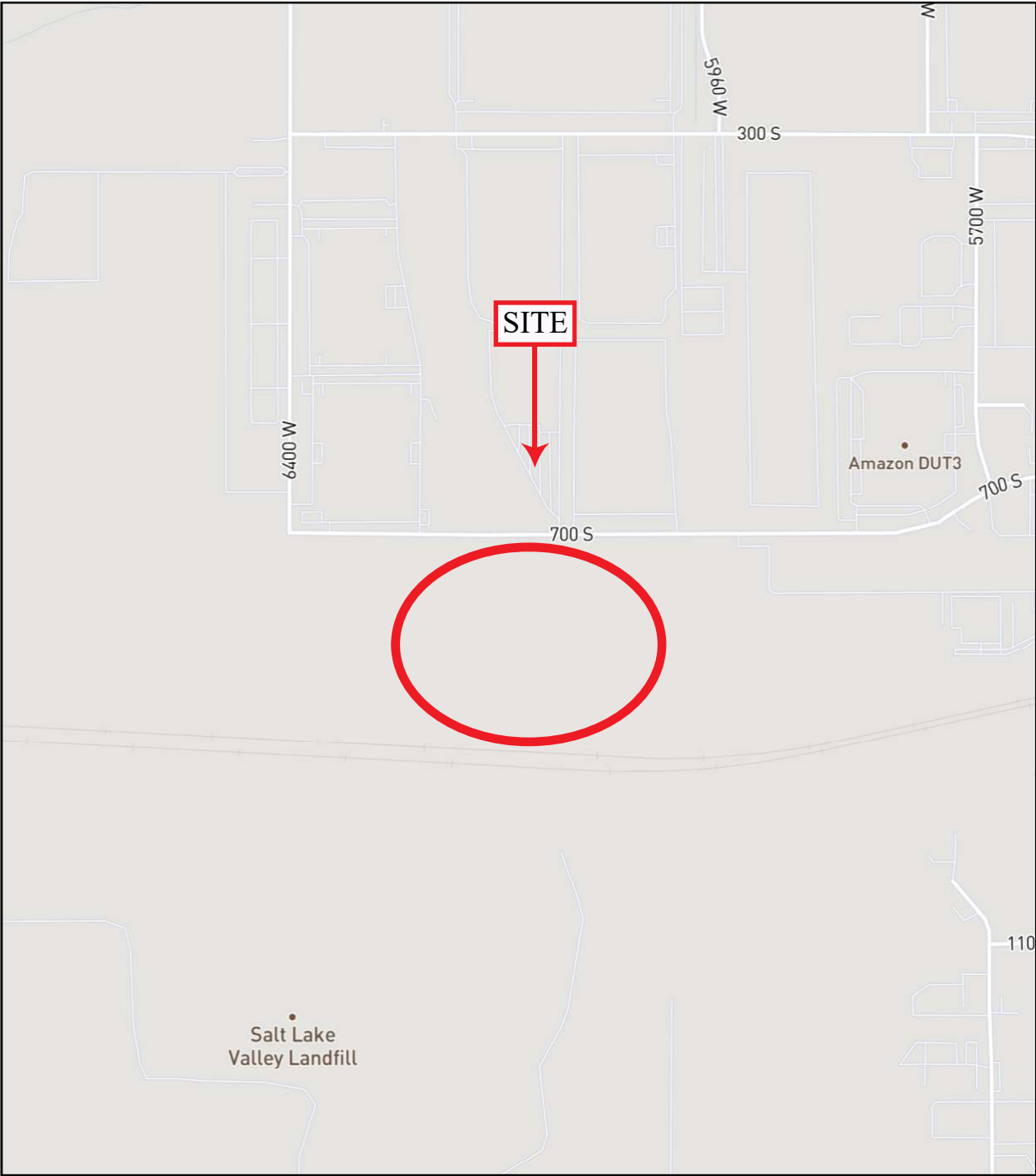


GAL/ADS:jmt

Encl. Figure 1, Vicinity Map
Figure 2, Site Plan
Figures 3A through 3AD, Boring Logs
Figure 4, Key to Boring Log (USCS)

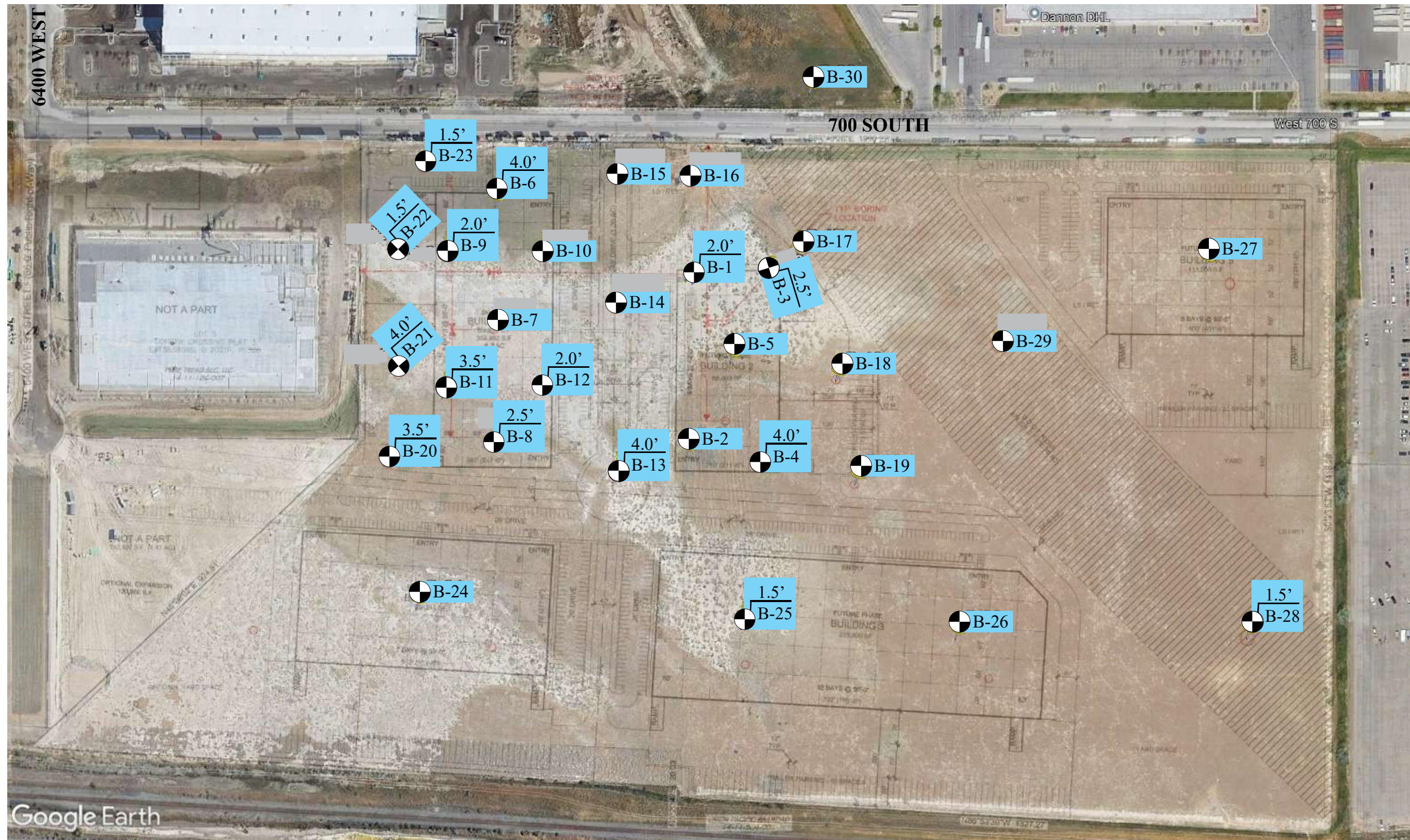
Addressee (email)

³ Idriss, I. M., and Boulanger, R. W. (2014), Soil liquefaction during earthquakes: Monograph MNO-12, Earthquake Engineering Research Institute, Oakland, CA, 261 pp.



REFERENCE:
ALL TRAILS - NATIONAL GEOGRAPHIC TERRAIN
DATED 2024

FIGURE 1
VICINITY MAP
 GSH



REFERENCE:
ADAPTED FROM AERIAL PHOTOGRAPH
DOWNLOADED FROM GOOGLE EARTH
IMAGERY NOT DATED



KEY:

Depth of Non-engineered Fill (feet)
/ Boring Number (feet)

FIGURE 2
SITE PLAN

GSH



GSH

BORING LOG

Page: 1 of 1

BORING: B-1

CLIENT: Property Reserve

PROJECT NUMBER: 3994-001-24

PROJECT: Prop. 700 S PSP Office/Warehouse Distribution Facility-Bldgs 1 and 2

DATE STARTED: 9/26/24

DATE FINISHED: 9/26/24

LOCATION: Southeast Corner of 700 South 6400 West Street, Salt Lake City, Utah

GSH FIELD REP.: JC

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 0.4' (10/15/24)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								
	SM/SC	SILTY/CLAYEY SAND with major roots (topsoil) to 6"; tan/brown									saturated loose/disturbed
	CL	SILTY CLAY with fine sand; oxidation; brown/gray		10							saturated medium stiff
		grades fine sandy clay	5	5		32.9	84				
		grades silty clay with fine sand	10	7							
		End of Exploration at 11.5'. Installed 1.25" diameter slotted PVC pipe to 11.5'.									

See Subsurface Conditions section in the report for additional information.

FIGURE 3A



GSH

BORING LOG

Page: 1 of 1

BORING: B-2

CLIENT: Property Reserve

PROJECT NUMBER: 3994-001-24

PROJECT: Prop. 700 S PSP Office/Warehouse Distribution Facility-Bldgs 1 and 2

DATE STARTED: 9/30/24

DATE FINISHED: 9/30/24

LOCATION: Southeast Corner of 700 South 6400 West Street, Salt Lake City, Utah

GSH FIELD REP.: RS

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 10.0' (9/30/24)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
	CL	Ground Surface	0								slightly moist stiff
		SILTY CLAY with trace fine sand; major roots (topsoil) to 6"; gray		12		26.7	93				
		grades fine sandy clay	5	13							moist
		grades with trace fine sand	10	9							saturated medium stiff
			15	15		27.6	95				stiff
		End of Exploration at 16.5'. No groundwater encountered at time of drilling.									
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3B



GSH

BORING LOG

Page: 1 of 1

BORING: B-3

CLIENT: Property Reserve

PROJECT NUMBER: 3994-001-24

PROJECT: Prop. 700 S PSP Office/Warehouse Distribution Facility-Bldgs 1 and 2

DATE STARTED: 9/30/24

DATE FINISHED: 9/30/24

LOCATION: Southeast Corner of 700 South 6400 West Street, Salt Lake City, Utah

GSH FIELD REP.: RS

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 15.0' (9/30/24)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								
	CL FILL	SILTY CLAY, FILL with some fine to coarse sand; major roots (topsoil) to 6"; brown									slightly moist medium stiff
	CL	SILTY CLAY with trace fine sand; gray		10		25.8	96				slightly moist medium stiff
		grades with layers of fine sand up to 1" thick	5	10							
		grades gray/blue	10	6							moist
	SM	SILTY FINE TO COARSE SAND gray									moist medium dense
			15	30							saturated
			20	34							
		End of Exploration at 21.5'.									
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3C



GSH

BORING LOG

Page: 1 of 1

BORING: B-4

CLIENT: Property Reserve

PROJECT NUMBER: 3994-001-24

PROJECT: Prop. 700 S PSP Office/Warehouse Distribution Facility-Bldgs 1 and 2

DATE STARTED: 9/30/24

DATE FINISHED: 9/30/24

LOCATION: Southeast Corner of 700 South 6400 West Street, Salt Lake City, Utah

GSH FIELD REP.: RS

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 10.0' (9/30/24)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								slightly moist stiff
	CL FILL	SILTY CLAY, FILL with some fine to coarse sand; major roots (topsoil) to 6"; brown		13							
											slightly moist medium stiff
	CL	SILTY CLAY with layers of fine sand up to 1" thick; gray	5	6		28.9	90				
											saturated
		grades with layers of fine sand up to 3" thick	10	7							
		End of Exploration at 11.5'. No groundwater encountered at time of drilling.									
			15								
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3D



GSH

BORING LOG

Page: 1 of 1

BORING: B-5

CLIENT: Property Reserve

PROJECT NUMBER: 3994-001-24

PROJECT: Prop. 700 S PSP Office/Warehouse Distribution Facility-Bldgs 1 and 2

DATE STARTED: 9/30/24

DATE FINISHED: 9/30/24

LOCATION: Southeast Corner of 700 South 6400 West Street, Salt Lake City, Utah

GSH FIELD REP.: RS

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 15.0' (9/30/24)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								
	CL	SILTY CLAY with some fine to coarse sand; major roots (topsoil) to 6"; brown grades gray		10		27.2	86				slightly moist medium stiff
			5	10							
			10	11							
		grades with layers of fine sand up to 3" thick									
	SM/ SC	SILTY/CLAYEY FINE TO MEDIUM SAND gray		27							moist medium dense
			15								saturated
		End of Exploration at 16.5'.									
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3E



GSH

BORING LOG

Page: 1 of 1

BORING: B-6

CLIENT: Property Reserve

PROJECT NUMBER: 3994-001-24

PROJECT: Prop. 700 S PSP Office/Warehouse Distribution Facility-Bldgs 1 and 2

DATE STARTED: 9/26/24

DATE FINISHED: 9/26/24

LOCATION: Southeast Corner of 700 South 6400 West Street, Salt Lake City, Utah

GSH FIELD REP.: RS

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 5.0' (9/26/24)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								
	CL FILL	SILTY CLAY, FILL with some fine to coarse sand; major roots (topsoil) to 6"; brown		7							slightly moist medium stiff
	CL	SILTY CLAY with some fine sand; gray	5	15							saturated stiff
			10	11		30.4	89				
	SM/ SC	SILTY/CLAYEY FINE TO COARSE SAND with layers of clay up to 1" thick; gray	15	34							saturated medium dense
		End of Exploration at 16.5'.									
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3F



GSH

BORING LOG

Page: 1 of 1

BORING: B-7

CLIENT: Property Reserve

PROJECT NUMBER: 3994-001-24

PROJECT: Prop. 700 S PSP Office/Warehouse Distribution Facility-Bldgs 1 and 2

DATE STARTED: 9/27/24

DATE FINISHED: 9/27/24

LOCATION: Southeast Corner of 700 South 6400 West Street, Salt Lake City, Utah

GSH FIELD REP.: JC

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 15.0' (9/27/24)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								
	SM/ SC	SILTY/CLAYEY FINE TO COARSE SAND with major roots (topsoil) to 6"; tan/brown									slightly moist medium dense
	CL	SILTY CLAY with layers of fine to coarse sand up to 1" thick; brown/gray		7							moist medium stiff
			5	9							
			10	6		30.8	91				very moist
		grades with layers of fine to coarse silty sand up to 3" thick; brown									
			15	26							saturated medium dense
	SM	SILTY FINE TO COARSE SAND with trace clay; gray									
		End of Exploration at 16.5'.									
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3G



GSH

BORING LOG

Page: 1 of 1

BORING: B-8

CLIENT: Property Reserve

PROJECT NUMBER: 3994-001-24

PROJECT: Prop. 700 S PSP Office/Warehouse Distribution Facility-Bldgs 1 and 2

DATE STARTED: 9/26/24

DATE FINISHED: 9/26/24

LOCATION: Southeast Corner of 700 South 6400 West Street, Salt Lake City, Utah

GSH FIELD REP.: RS

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 15.0' (9/26/24)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								
	CL FILL	FINE TO COARSE SANDY CLAY, FILL with some silt; major roots (topsoil) to 6"; brown									slightly moist medium stiff
	CL	SILTY CLAY with trace fine sand; tan		20	⬥						slightly moist stiff
			5	9	⬥	34.3	81				medium stiff
		grades dark gray	10	6	⬥	34.4	87				moist
	SM	SILTY FINE TO MEDIUM SAND dark gray	15	11	⬥	25.6		31.7			moist loose saturated
		End of Exploration at 16.5'.									
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3H



GSH

BORING LOG

Page: 1 of 1

BORING: B-9

CLIENT: Property Reserve

PROJECT NUMBER: 3994-001-24

PROJECT: Prop. 700 S PSP Office/Warehouse Distribution Facility-Bldgs 1 and 2

DATE STARTED: 9/26/24

DATE FINISHED: 9/26/24

LOCATION: Southeast Corner of 700 South 6400 West Street, Salt Lake City, Utah

GSH FIELD REP.: RS

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 10.0' (9/26/24)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								
	CL FILL	FINE TO COARSE SANDY CLAY, FILL with some silt; major roots (topsoil) to 6"; brown									slightly moist medium stiff
	CL	SILTY CLAY with trace fine sand; brown									slightly moist medium stiff
			5								
				7	⬇						
		grades with layers of fine sand up to 1/2" thick		8	⬇						
	SM	SILTY FINE SAND with layers of silty clay up to 1/4" thick; brown/green	10								very loose saturated
				9	⬇	26.5		75.6			
		End of Exploration at 11.5'.									
			15								
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 31



GSH

BORING LOG

Page: 1 of 1

BORING: B-10

CLIENT: Property Reserve

PROJECT NUMBER: 3994-001-24

PROJECT: Prop. 700 S PSP Office/Warehouse Distribution Facility-Bldgs 1 and 2

DATE STARTED: 9/26/24

DATE FINISHED: 9/26/24

LOCATION: Southeast Corner of 700 South 6400 West Street, Salt Lake City, Utah

GSH FIELD REP.: JC

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 0.6' (10/15/24)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								
	SM/SC	SILTY/CLAYEY FINE TO COARSE SAND with major roots (topsoil) to 6"; tan/brown									saturated medium dense
	CL	SILTY CLAY brown		7							saturated medium stiff
		grades with trace fine to coarse sand; gray/brown	5	5		34.6	85				
		grades with fine sand; black/gray	10	5							
	SP	FINE TO COARSE SAND with trace silt; gray	15	18		27.6		4.9			saturated loose
		End of Exploration at 16.5'. Installed 1.25" diameter slotted PVC pipe to 16.5'.									
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3J



GSH

BORING LOG

Page: 1 of 1

BORING: B-11

CLIENT: Property Reserve

PROJECT NUMBER: 3994-001-24

PROJECT: Prop. 700 S PSP Office/Warehouse Distribution Facility-Bldgs 1 and 2

DATE STARTED: 9/26/24

DATE FINISHED: 9/26/24

LOCATION: Southeast Corner of 700 South 6400 West Street, Salt Lake City, Utah

GSH FIELD REP.: RS

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 4.0' (10/15/24)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								
	CL FILL	SILTY CLAY, FILL with some fine to coarse sand; major roots (topsoil) to 6"; brown									slightly moist medium stiff
				8		28.0	92				
	CL	SILTY CLAY with trace fine sand; oxidation; gray	5								saturated medium stiff
				8							
	SM/ SC	SILTY/CLAYEY FINE TO MEDIUM SAND gray	10								saturated loose
				21							
		End of Exploration at 11.5'. Installed 1.25" diameter slotted PVC pipe to 11.5'.									
			15								
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3K



GSH

BORING LOG

Page: 1 of 2

BORING: B-12

CLIENT: Property Reserve

PROJECT NUMBER: 3994-001-24

PROJECT: Prop. 700 S PSP Office/Warehouse Distribution Facility-Bldgs 1 and 2 DATE STARTED: 9/26/24 DATE FINISHED: 9/26/24

LOCATION: Southeast Corner of 700 South 6400 West Street, Salt Lake City, Utah

GSH FIELD REP.: RS

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 10.0' (9/26/24)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								
	CL FILL	SILTY CLAY, FILL with some fine to coarse sand; major roots (topsoil) to 6"; brown									slightly moist medium stiff
	CL	FINE SANDY CLAY brown		8							slightly moist medium stiff
		grades silty clay with trace fine sand; gray	5	3							soft
		grades with layers of fine to coarse sand up to 6" thick	10	7							saturated medium stiff
	SM	SILTY FINE TO COARSE SAND with layers of silty clay up to 6" thick; brown	15	14		25.2		31.6			saturated medium dense
	SP/ SM	FINE TO COARSE SAND with some silt and layers of clay up to 1/4" thick; brown	20	7		32.1		10.8			saturated loose
			25								medium dense

See Subsurface Conditions section in the report for additional information.

FIGURE 3L



GSH

BORING LOG

Page: 2 of 2

BORING: B-12

CLIENT: Property Reserve

PROJECT NUMBER: 3994-001-24

PROJECT: Prop. 700 S PSP Office/Warehouse Distribution Facility-Bldgs 1 and 2

DATE STARTED: 9/26/24

DATE FINISHED: 9/26/24

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
			25								
		grades gray		16		20.4		7.3			
		grades with fine gravel	30	30							dense
		grades with layers of silty clay up to 1" thick	35	10		21.7		7.1			loose
		Refusal at 40.0' due to heaving sand soils.	40								9' heave
			45								
			50								

See Subsurface Conditions section in the report for additional information.

FIGURE 3L
(continued)



GSH

BORING LOG

Page: 1 of 1

BORING: B-13

CLIENT: Property Reserve

PROJECT NUMBER: 3994-001-24

PROJECT: Prop. 700 S PSP Office/Warehouse Distribution Facility-Bldgs 1 and 2

DATE STARTED: 9/26/24

DATE FINISHED: 9/26/24

LOCATION: Southeast Corner of 700 South 6400 West Street, Salt Lake City, Utah

GSH FIELD REP.: RS

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 10.0' (9/26/24)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								
	CL FILL	SILTY CLAY, FILL with some fine to coarse sand; major roots (topsoil) to 6"; brown		6							slightly moist medium stiff
	CL	SILTY CLAY gray	5	3							slightly moist soft
	SM/ SC	SILTY/CLAYEY FINE TO MEDIUM SAND gray	10	13		25.5		41.8			moist loose
		End of Exploration at 11.5'.									saturated
			15								
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3M



GSH

BORING LOG

Page: 1 of 1

BORING: B-14

CLIENT: Property Reserve

PROJECT NUMBER: 3994-001-24

PROJECT: Prop. 700 S PSP Office/Warehouse Distribution Facility-Bldgs 1 and 2

DATE STARTED: 9/26/24

DATE FINISHED: 9/26/24

LOCATION: Southeast Corner of 700 South 6400 West Street, Salt Lake City, Utah

GSH FIELD REP.: RS

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 10.0' (9/26/24)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								slightly moist medium stiff
	CL	FINE TO MEDIUM SANDY CLAY with major roots (topsoil) to 6"; brown									
		grades gray		7	⬇	30.9	90				
		grades silty clay	5								moist soft
				3	⬇						
	SM/ SC	SILTY/CLAYEY FINE TO COARSE SAND gray									moist very loose
			10								saturated
				5	⬇	30.8		22.2			
		End of Exploration at 11.5'.									
			15								
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3N



GSH

BORING LOG

Page: 1 of 1

BORING: B-15

CLIENT: Property Reserve

PROJECT NUMBER: 3994-001-24

PROJECT: Prop. 700 S PSP Office/Warehouse Distribution Facility-Bldgs 1 and 2

DATE STARTED: 9/26/24

DATE FINISHED: 9/26/24

LOCATION: Southeast Corner of 700 South 6400 West Street, Salt Lake City, Utah

GSH FIELD REP.: RS

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 9.3' (10/15/24)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								slightly moist very stiff
	CL	FINE SANDY CLAY with some silt; major roots (topsoil) to 6"; tan		46							
			5	24							stiff
			10	7		27.7	84				saturated medium stiff
		grades silty clay with trace fine sand; brown									
		End of Exploration at 11.5'. Installed 1.25" diameter slotted PVC pipe to 11.5'.									
			15								
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 30



GSH

BORING LOG

Page: 1 of 1

BORING: B-16

CLIENT: Property Reserve

PROJECT NUMBER: 3994-001-24

PROJECT: Proposed 700 South PSP Office/Warehouse Distribution Facility

DATE STARTED: 9/30/24

DATE FINISHED: 9/30/24

LOCATION: Southeast Corner of 700 South 6400 West Street, Salt Lake City, Utah

GSH FIELD REP.: RS

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: Not Encountered (9/30/24)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								
	CL	SILTY CLAY with some fine to medium sand; major roots (topsoil) to 6"; brown									slightly moist soft
		grades with layers of fine to medium sand up to 4" thick									
		grades with trace fine sand; gray	5								moist medium stiff
		End of Exploration at 5.5'. No groundwater encountered at time of drilling.									
			10								
			15								
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3P



GSH

BORING LOG

Page: 1 of 1

BORING: B-17

CLIENT: Property Reserve

PROJECT NUMBER: 3994-001-24

PROJECT: Proposed 700 South PSP Office/Warehouse Distribution Facility

DATE STARTED: 9/30/24

DATE FINISHED: 9/30/24

LOCATION: Southeast Corner of 700 South 6400 West Street, Salt Lake City, Utah

GSH FIELD REP.: RS

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: Not Encountered (9/30/24)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								
	CL	SILTY CLAY with trace fine sand; major roots (topsoil) to 6"; gray									moist medium stiff
			5								
		End of Exploration at 5.5'. No groundwater encountered at time of drilling.									
			10								
			15								
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3Q



GSH

BORING LOG

Page: 1 of 1

BORING: B-18

CLIENT: Property Reserve

PROJECT NUMBER: 3994-001-24

PROJECT: Proposed 700 South PSP Office/Warehouse Distribution Facility

DATE STARTED: 9/30/24

DATE FINISHED: 9/30/24

LOCATION: Southeast Corner of 700 South 6400 West Street, Salt Lake City, Utah

GSH FIELD REP.: RS

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: Not Encountered (9/30/24)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								
	CL	SILTY CLAY with trace fine sand; major roots (topsoil) to 6"; brown									slightly moist stiff
			5								
		End of Exploration at 5.5'. No groundwater encountered at time of drilling.									
			10								
			15								
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3R



GSH

BORING LOG

Page: 1 of 1

BORING: B-19

CLIENT: Property Reserve

PROJECT NUMBER: 3994-001-24

PROJECT: Proposed 700 South PSP Office/Warehouse Distribution Facility

DATE STARTED: 9/30/24

DATE FINISHED: 9/30/24

LOCATION: Southeast Corner of 700 South 6400 West Street, Salt Lake City, Utah

GSH FIELD REP.: RS

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: Not Encountered (9/30/24)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								
	CL	SILTY CLAY with trace fine sand; major roots (topsoil) to 6"; brown									slightly moist medium stiff
		grades gray	5								
		End of Exploration at 5.5'. No groundwater encountered at time of drilling.									
			10								
			15								
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3S



GSH

BORING LOG

Page: 1 of 1

BORING: B-20

CLIENT: Property Reserve

PROJECT NUMBER: 3994-001-24

PROJECT: Proposed 700 South PSP Office/Warehouse Distribution Facility

DATE STARTED: 9/30/24

DATE FINISHED: 9/30/24

LOCATION: Southeast Corner of 700 South 6400 West Street, Salt Lake City, Utah

GSH FIELD REP.: JC

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: Not Encountered (9/30/24)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								
	CL FILL	FINE TO MEDIUM SANDY CLAY, FILL with fine and coarse gravel and trace clay; major roots (topsoil) to 6"; brown									slightly moist medium stiff
	CL	SILTY CLAY with trace fine sand; brown									moist medium stiff
		End of Exploration at 5.5'. No groundwater encountered at time of drilling.									
			10								
			15								
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3T



GSH

BORING LOG

Page: 1 of 1

BORING: B-21

CLIENT: Property Reserve

PROJECT NUMBER: 3994-001-24

PROJECT: Proposed 700 South PSP Office/Warehouse Distribution Facility

DATE STARTED: 9/30/24

DATE FINISHED: 9/30/24

LOCATION: Southeast Corner of 700 South 6400 West Street, Salt Lake City, Utah

GSH FIELD REP.: JC

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 5.0' (9/30/24)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								
	SM/ SC FILL	SILTY/CLAYEY FINE TO COARSE SAND, FILL with major roots (topsoil) to 6"; brown									dry
		grades brown/gray									very moist
	SM/ SC	SILTY FINE SAND with some clay; brown	5								very moist medium dense saturated
		End of Exploration at 5.5'.									
			10								
			15								
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3U



BORING LOG

Page: 1 of 1

BORING: B-22

CLIENT: Property Reserve

PROJECT NUMBER: 3994-001-24

PROJECT: Proposed 700 South PSP Office/Warehouse Distribution Facility DATE STARTED: 9/27/24 DATE FINISHED: 9/27/24

LOCATION: Southeast Corner of 700 South 6400 West Street, Salt Lake City, Utah

GSH FIELD REP.: JC

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: Not Encountered (9/27/24)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								slightly moist loose
	SM/ SC FILL	SILTY/CLAYEY FINE TO COARSE SAND, FILL with major roots (topsoil) to 6"; tan/brown									
	CL	SILTY CLAY with trace fine sand; brown/gray									moist medium stiff
		sand grades out	5								very moist
		End of Exploration at 5.5'. No groundwater encountered at time of drilling.									
			10								
			15								
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3V



GSH

BORING LOG

Page: 1 of 1

BORING: B-23

CLIENT: Property Reserve

PROJECT NUMBER: 3994-001-24

PROJECT: Proposed 700 South PSP Office/Warehouse Distribution Facility

DATE STARTED: 9/27/24

DATE FINISHED: 9/27/24

LOCATION: Southeast Corner of 700 South 6400 West Street, Salt Lake City, Utah

GSH FIELD REP.: JC

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: Not Encountered (9/27/24)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								
	CL FILL	FINE TO COARSE SANDY CLAY, FILL with major roots (topsoil) to 6"; brown									slightly moist soft
	CL	SILTY CLAY with trace fine sand; brown/gray									moist medium stiff
		sand grades out	5								very moist
		End of Exploration at 5.5'. No groundwater encountered at time of drilling.									
			10								
			15								
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3W



GSH

BORING LOG

Page: 1 of 1

BORING: B-24

CLIENT: Property Reserve

PROJECT NUMBER: 3994-001-24

PROJECT: Proposed 700 South PSP Office/Warehouse Distribution Facility

DATE STARTED: 9/26/24

DATE FINISHED: 9/26/24

LOCATION: Southeast Corner of 700 South 6400 West Street, Salt Lake City, Utah

GSH FIELD REP.: RS

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 2.0' (10/15/24)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								moist medium stiff
	CL	FINE TO MEDIUM SANDY CLAY with layers of fine to coarse sand up to 1" thick; major roots (topsoil) to brown									saturated
				9		24.2		90.9			
		grades fine sandy clay; dark gray	5								
				8		29.5	91				
		grades with layers of fine to medium sand up to 1" thick	10								
				10							
	SM	SILTY FINE TO MEDIUM SAND with trace clay; dark gray	15								saturated medium dense
				35							
		End of Exploration at 16.5'. Installed 1.25" diameter slotted PVC pipe to 16.5'.									
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3X



GSH

BORING LOG

Page: 1 of 1

BORING: B-25

CLIENT: Property Reserve

PROJECT NUMBER: 3994-001-24

PROJECT: Proposed 700 South PSP Office/Warehouse Distribution Facility

DATE STARTED: 9/30/24

DATE FINISHED: 9/30/24

LOCATION: Southeast Corner of 700 South 6400 West Street, Salt Lake City, Utah

GSH FIELD REP.: RS

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 3.8' (10/15/24)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								
	CL FILL	SILTY CLAY, FILL with some fine to coarse sand; major roots (topsoil) to 6"; brown									slightly moist medium stiff
	CL	FINE TO MEDIUM SANDY CLAY gray		7	⬇						slightly moist medium stiff
											saturated
			5	9	⬇						
		grades silty clay with trace fine sand									
	SP/ SM	FINE TO MEDIUM SAND with some silt; gray	10	23	⬇						loose saturated
	SM	SILTY FINE TO MEDIUM SAND brown	15	23	⬇						saturated loose
		End of Exploration at 16.5'. Installed 1.25" diameter slotted PVC pipe to 16.5'.									
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3Y



GSH

BORING LOG

Page: 1 of 1

BORING: B-26

CLIENT: Property Reserve

PROJECT NUMBER: 3994-001-24

PROJECT: Proposed 700 South PSP Office/Warehouse Distribution Facility

DATE STARTED: 9/30/24

DATE FINISHED: 9/30/24

LOCATION: Southeast Corner of 700 South 6400 West Street, Salt Lake City, Utah

GSH FIELD REP.: RS

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 15.0' (9/30/24)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								slightly moist stiff
				16	⬇						
			5	7	⬇						medium stiff
		grades gray	10	7	⬇						moist
			15	23	⬇						saturated very stiff
		End of Exploration at 16.5'.									
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3Z



GSH

BORING LOG

Page: 1 of 1

BORING: B-27

CLIENT: Property Reserve

PROJECT NUMBER: 3994-001-24

PROJECT: Proposed 700 South PSP Office/Warehouse Distribution Facility

DATE STARTED: 9/30/24

DATE FINISHED: 9/30/24

LOCATION: Southeast Corner of 700 South 6400 West Street, Salt Lake City, Utah

GSH FIELD REP.: RS

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 10.0' (9/30/24)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
	CL	Ground Surface	0								slightly moist stiff
		SILTY CLAY with trace fine sand; major roots (topsoil) to 6"; brown		12							
			5	9		33.9	83				medium stiff
		grades gray									
		grades brown	10	9							saturated
			15	14							stiff
		End of Exploration at 16.5'. No groundwater encountered at time of drilling.									
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3AA



GSH

BORING LOG

Page: 1 of 1

BORING: B-28

CLIENT: Property Reserve

PROJECT NUMBER: 3994-001-24

PROJECT: Proposed 700 South PSP Office/Warehouse Distribution Facility

DATE STARTED: 9/30/24

DATE FINISHED: 9/30/24

LOCATION: Southeast Corner of 700 South 6400 West Street, Salt Lake City, Utah

GSH FIELD REP.: RS

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 6.7' (10/15/24)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								
	CL FILL	SILTY CLAY, FILL with some fine to coarse sand; major roots (topsoil) to 6"; brown									slightly moist medium stiff
	CL	SILTY CLAY with trace fine sand; brown									moist stiff
			19								
			5								
			9								medium stiff saturated
			10								
			9			31.8	89				
			15								
			12								stiff
		End of Exploration at 16.5'. Installed 1.25" diameter slotted PVC pipe to 16.5'.									
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3AB



GSH

BORING LOG

Page: 1 of 1

BORING: B-29

CLIENT: Property Reserve

PROJECT NUMBER: 3994-001-24

PROJECT: Proposed 700 South PSP Office/Warehouse Distribution Facility

DATE STARTED: 9/30/24

DATE FINISHED: 9/30/24

LOCATION: Southeast Corner of 700 South 6400 West Street, Salt Lake City, Utah

GSH FIELD REP.: RS

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 10.0' (9/30/24)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								slightly moist stiff
	CL	SILTY CLAY with trace fine sand; layers of fine to medium sand up to 2" thick; major roots (topsoil) to 6"; brown		12		28.5	83				
			5	7							medium stiff
		grades gray	10	9							saturated
	SM/ SC	SILTY/CLAYEY FINE TO MEDIUM SAND with layers of silty clay up to 1" thick; gray	15	8		28.8		61.1			saturated very loose
		End of Exploration at 16.5'. No groundwater encountered at time of drilling.									
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3AC



GSH

BORING LOG

Page: 1 of 1

BORING: B-30

CLIENT: Property Reserve

PROJECT NUMBER: 3994-001-24

PROJECT: Proposed 700 South PSP Office/Warehouse Distribution Facility

DATE STARTED: 9/30/24

DATE FINISHED: 9/30/24

LOCATION: Southeast Corner of 700 South 6400 West Street, Salt Lake City, Utah

GSH FIELD REP.: RS

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 6.3' (10/15/24)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								slightly moist stiff
		CL SILTY CLAY with trace fine sand; major roots (topsoil) to 6"; brown		15							
		SM/SC SILTY/CLAYEY FINE TO MEDIUM SAND gray	5	5		18.1		40.3			moist very loose
		CL FINE TO MEDIUM SANDY CLAY gray									saturated saturated medium stiff
			10	9							
			15	14							stiff
		End of Exploration at 16.5'. No groundwater encountered at time of drilling. Installed 1.25" diameter slotted PVC pipe to 16.5'.									
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3AD

CLIENT: Property Reserve
 PROJECT: Proposed 700 South PSP Office/Warehouse Distribution Facility
 PROJECT NUMBER: 3994-001-24

KEY TO BORING LOG

WATER LEVEL	USCS	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪	⑫
COLUMN DESCRIPTIONS											
①	Water Level: Depth to measured groundwater table. See symbol below.										
②	USCS: (Unified Soil Classification System) Description of soils encountered; typical symbols are explained below.										
③	Description: Description of material encountered; may include color, moisture, grain size, density/consistency,										
④	Depth (ft.): Depth in feet below the ground surface.										
⑤	Blow Count: Number of blows to advance sampler 12" beyond first 6", using a 140-lb hammer with 30" drop.										
⑥	Sample Symbol: Type of soil sample collected at depth interval shown; sampler symbols are explained below.										
⑦	Moisture (%): Water content of soil sample measured in laboratory; expressed as percentage of dryweight of										
⑧	Dry Density (pcf): The density of a soil measured in laboratory; expressed in pounds per cubic foot.										
⑨	% Passing 200: Fines content of soils sample passing a No. 200 sieve; expressed as a percentage.										
⑩	Liquid Limit (%): Water content at which a soil changes from plastic to liquid behavior.										
⑪	Plasticity Index (%): Range of water content at which a soil exhibits plastic properties.										
⑫	Remarks: Comments and observations regarding drilling or sampling made by driller or field personnel. May include other field and laboratory test results using the following abbreviations:										
			CEMENTATION:		MODIFIERS:		MOISTURE CONTENT (FIELD TEST):				
			Weakly: Crumbles or breaks with handling or slight finger pressure.		Trace <5%		Dry: Absence of moisture, dusty, dry to the touch.				
			Moderately: Crumbles or breaks with considerable finger pressure.		Some 5-12%		Moist: Damp but no visible water.				
			Strongly: Will not crumble or break with finger pressure.		With > 12%		Saturated: Visible water, usually soil below water table.				
Descriptions and stratum lines are interpretive; field descriptions may have been modified to reflect lab test results. Descriptions on the 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.											
UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)											
MAJOR DIVISIONS			USCS SYMBOLS	TYPICAL DESCRIPTIONS							
COARSE-GRAINED SOILS More than 50% of material is larger than No. 200 sieve size.	GRAVELS More than 50% of coarse fraction retained on No. 4 sieve.	CLEAN GRAVELS (little or no fines)	GW	Well-Graded Gravels, Gravel-Sand Mixtures, Little or No Fines							
		GRAVELS WITH FINES (appreciable amount of fines)	GP	Poorly-Graded Gravels, Gravel-Sand Mixtures, Little or No Fines							
			GM	Silty Gravels, Gravel-Sand-Silt Mixtures							
		CLEAN SANDS (little or no fines)	SW	Well-Graded Sands, Gravelly Sands, Little or No Fines							
	SANDS WITH FINES (appreciable amount of fines)		SP	Poorly-Graded Sands, Gravelly Sands, Little or No Fines							
		FINE-GRAINED SOILS More than 50% of material is smaller than No. 200 sieve size.	SILTS AND CLAYS Liquid Limit less than 50%	SM	Silty Sands, Sand-Silt Mixtures						
SC	Clayey Sands, Sand-Clay Mixtures										
ML	Inorganic Silts and Very Fine Sands, Rock Flour, Silty or Clayey Fine Sands or Clayey Silts with Slight Plasticity										
SILTS AND CLAYS Liquid Limit greater than 50%	CL		Inorganic Clays of Low to Medium Plasticity, Gravelly Clays, Sandy Clays, Silty Clays, Lean Clays								
	MH		OL	Organic Silts and Organic Silty Clays of Low Plasticity							
			CH	Inorganic Clays of High Plasticity, Fat Clays							
		OH	Organic Silts and Organic Clays of Medium to High Plasticity								
HIGHLY ORGANIC SOILS			PT	Peat, Humus, Swamp Soils with High Organic Contents							
DESCRIPTION	THICKNESS										
Seam	up to 1/8"										
Layer	1/8" to 12"										
	Bulk/Bag Sample										
	Standard Penetration Split Spoon Sampler										
	Rock Core										
	No Recovery										
	3.25" OD, 2.42" ID D&M Sampler										
	3.0" OD, 2.42" ID D&M Sampler										
	California Sampler										
	Thin Wall										

Note: Dual Symbols are used to indicate borderline soil classifications.

FIGURE 4





March 17, 2025
Job No. 3994-01A-25

Ms. Mary Cunningham
Property Reserve
51 South Main, Suite 301
Salt Lake City, Utah 84111

Ms. Cunningham:

Re: Letter – Addendum
Geotechnical Study Update
700 South PSP Office/Warehouse Distribution Facility – Building 3
Southeast Corner of 700 South and 6400 West Street
Salt Lake City, Utah

Introduction

This letter presents the results of the additional borings completed at the above-referenced site. The general location of the site with respect to existing roadways, as of 2025, is presented on Figure 1, Vicinity Map. A more detailed layout of the site showing existing structures, topography, proposed facilities, the additional borings completed in conjunction with this study is presented on Figure 2, Site Plan. GSH Geotechnical, Inc. (GSH) completed a geotechnical study for the above-referenced site, dated October 16, 2024¹. This letter is to serve as a design level geotechnical study for Building 3 as well as an addendum to the referenced geotechnical study.

Proposed Construction

Since the time of the original geotechnical study, the design of the proposed construction has been updated to include the layout and construction of Building 3. A 1- to 2-level, slab-on-grade office/warehouse structure with a footprint of approximately 235,800 square feet and adjoining pavements are proposed for the site. The structure is anticipated to be of tilt-up concrete construction and be supported by conventional spread and continuous wall foundations. Maximum wall and column loads are anticipated to be 5 to 6 kips per foot and 220 kips, respectively. Floor slab loads are anticipated to be approximately 150 pounds per square foot.

¹ “Report, Geotechnical Study, Proposed 700 South PSP Office/Warehouse Distribution Facility – Buildings 1 and 2, Southeast Corner of 700 South 6400 West Street, Salt Lake City, Utah.” GSH Job No 3994-001-24.

Summary

To further define and evaluate the subsurface soil and groundwater conditions across the site, 12 additional borings were completed within the accessible areas. These borings were completed to depths ranging from 5.5 to 26.5 feet below the existing ground surface with a truck-mounted drill rig equipped with hollow-stem augers. The approximate locations of the borings are presented on Figure 2. Additionally, two stormwater percolation tests to determine the percolation rate were performed in Borings B-11A and B-12A at a depth of 5.0 feet.

The field portion of our study was under the direct control and continual supervision of an experienced member of our geotechnical staff. During the course of the drilling operations, a continuous log of the subsurface conditions encountered was maintained. In addition, samples of the typical soils encountered were obtained for subsequent laboratory testing and examination. The soils were classified in the field based upon visual and textural examination. These classifications were supplemented by subsequent inspection and testing in our laboratory. Graphical representation of the subsurface conditions encountered is presented on Figures 3A through 3L, Boring Logs. Soils were classified in accordance with the nomenclature described on Figure 4, Key to Boring Log (USCS).

A 3.25-inch outside diameter, 2.42-inch inside diameter (Dames & Moore) and a 2.0-inch outside diameter, 1.38-inch inside diameter drive sampler (SPT) were utilized at select locations and depths. The blow counts recorded on the boring logs were those required to drive the sampler 12 inches with a 140-pound hammer dropping 30 inches.

Following completion of exploration operations, 1.25-inch diameter slotted PVC pipe was installed in Borings B-1A, B-2A, and B-5A through B-10A to provide a means of monitoring the groundwater fluctuations. The borings were backfilled with auger cuttings.

Lab Testing

To provide data necessary for our engineering analysis, a laboratory testing program was performed. This program included moisture, density, partial gradation, Atterberg limits, consolidation, and chemical tests. The following paragraphs describe the tests and summarize the test data.

Moisture and Density Tests

To provide index parameters and to correlate other test data, moisture and density tests were performed on selected samples. The results of these tests are presented on the boring logs, Figures 3A through 3L.

Partial Gradation Tests

To aid in classifying the granular soils, partial gradation tests were performed. Results of the tests are tabulated on the following page and presented on the boring logs, Figures 3A through 3L.

Boring No.	Depth (feet)	Percent Passing No. 200 Sieve	Moisture Content Percent	Soil Classification
B-1A	15.0	62.8	27.1	CL
B-10A	0.0	65.5	28.2	CL
B-11A	5.0	89.4	26.6	CL
B-12A	5.0	95.7	39.4	CL

Atterberg Limits Tests

To aid in classifying the soils, Atterberg limits tests were performed on representative samples of the fine-grained cohesive soils. Results of the tests are tabulated below and presented on the boring logs, Figures 3A through 3L:

Boring No.	Depth (feet)	Liquid Limit (percent)	Plastic Limit (percent)	Plasticity Index (percent)	Soil Classification
B-6	5.0	36	22	14	CL
	20.0	34	20	14	CL

Consolidation Tests

To provide data necessary for our settlement analysis, consolidation testing was performed on 3 representative samples of the natural fine-grained clay soils encountered at the site. The results of these tests indicate that the samples tested were moderately over-consolidated and will exhibit moderate strength and compressibility characteristics under the anticipated loading. Detailed results of the tests are maintained within our files and can be transmitted to you, upon your request.

Chemical Tests

To determine if the site soils will react detrimentally with concrete, chemical tests were performed on a representative sample of the near-surface soil encountered at the site. The results of the chemical tests are tabulated below:

Boring No.	Depth (feet)	Soil Classification	pH	Total Water-Soluble Sulfate (mg/kg-dry)
B-1	2.5	CL	8.1	54

Subsurface Conditions

The soil conditions encountered in each of the borings, to the depths completed, were generally similar to those encountered during the previously completed geotechnical study. The following provides generalized descriptions of the subsurface profiles and soil conditions encountered within the borings.

- Approximately 6 inches of topsoil was encountered in each boring. Topsoil thickness is frequently erratic and thicker zones of topsoil should be anticipated.
- Natural soils were encountered below the disturbed soil or ground surface in all boring locations. The natural soils consisted primarily of clay with varying silt and sand content and sand with varying clay and silt content.

For a more descriptive interpretation of subsurface conditions, please refer to Figures 3A through 3L, Boring Logs. The lines designating the interface between soil types on the boring logs generally represent approximate boundaries. In situ, the transitions between soils types may be gradual.

Groundwater was measured as shallow as 3.4 feet below ground surface within the additional borings and 0.4 feet in the original borings.

Groundwater Recommendations

On February 27, 2025 (6 days following excavation), groundwater was measured within the PVC pipe installed as tabulated below:

Boring No.	Groundwater Depth (feet)
	February 27, 2025
B-1A	4.5
B-5A	6.5
B-7A	3.4
B-8A	6.5
B-9A	6.2
B-10A	6.5

It must be noted that groundwater was encountered as shallow as 0.4 feet in the original borings. Based on the anticipated cuts necessary to reach design subgrades, we anticipate temporary and permanent dewatering and significant stabilization will be necessary. Floor slabs must be placed a minimum of 4 feet from the stabilized groundwater elevation or 1.5 feet if a perimeter subdrain system is utilized. A design for a foundation subdrain system will be provided, upon request. As

an alternative, site grading fill may be utilized to raise the overall grade to achieve the required separation between the floor slab and the highest groundwater elevation.

The groundwater measurements presented are conditions at the time of the field exploration and may not be representative of other times or locations. Groundwater levels may vary seasonally and with precipitation, as well as other factors including irrigation. Evaluation of these factors is beyond the scope of this study. Groundwater levels may, therefore, be at shallower or deeper depths than those measured during this study, including during construction and over the life of the structure.

The extent and nature of any dewatering required during construction will be dependent on the actual groundwater conditions prevalent at the time of construction and the effectiveness of construction drainage to prevent run-off into open excavations.

Stormwater Percolation Tests

An additional 2 stormwater percolation tests were performed at depths of approximately 5.0 feet in the representative natural clay soils at Borings B-11A and B-12A. The field percolation rate was 60 minutes per inch. This design percolation rate should be considered typical for the clayey soils at the site.

Groundwater was not encountered within Borings B-11A or B-12A at the time of the percolation test. However, it should be noted that groundwater was encountered at depths as shallow as 3.4 feet below ground surface within the additional borings and 0.4 feet in the original borings. The shallow depth to groundwater should be accounted for in the final design of the stormwater system.

Floor Slabs

GSH recommends that floor slabs be constructed a minimum of 4.0 feet from the stabilized groundwater elevation or 1.5 feet if a foundation subdrain system is utilized. A design for a foundation subdrain system will be provided, upon request. As an alternative, site grading fill may be utilized to raise the overall grade to achieve the required separation between the floor slab and the highest groundwater elevation.

If a vapor barrier is proposed to be utilized, GSH must be contacted for additional recommendations.

Cement Types

The laboratory tests indicate that the natural soils tested contain a negligible amount of water-soluble sulfates. Based on our test results, concrete in contact with the on-site soil will have a low potential for sulfate reaction (ACI 318, Table 4.3.1). Therefore, all concrete which will be in contact with the site soils may be prepared using Type I or IA cement.

Closure

All other recommendations presented in the referenced geotechnical study shall continue to be followed.

If you have any questions or would like to discuss these items further, please feel free to contact us at (801) 685-9190.

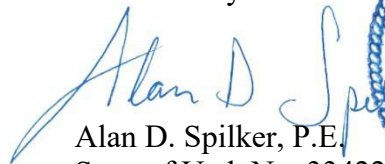
Respectfully submitted,

GSH Geotechnical, Inc.

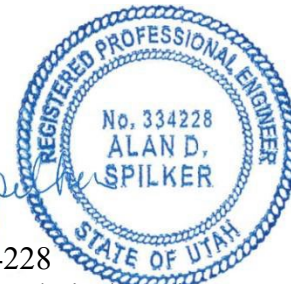


Gilbert Tingey
Staff Geologist, G.I.T.

Reviewed by:



Alan D. Spilker, P.E.
State of Utah No. 334228
President/Senior Geotechnical Engineer

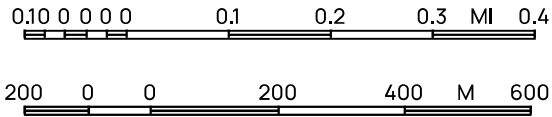
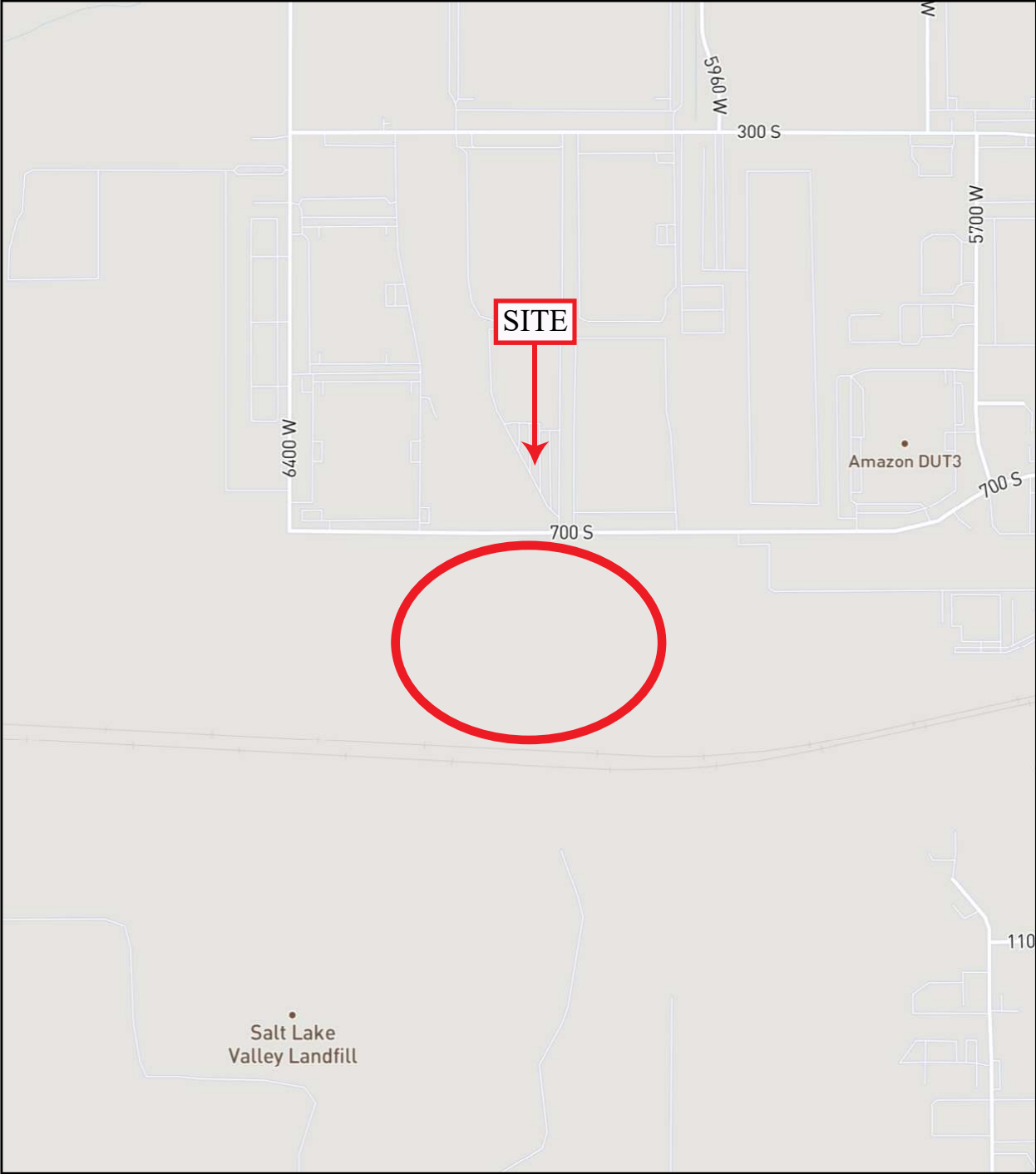


GT/ADS:jmt

Encl.

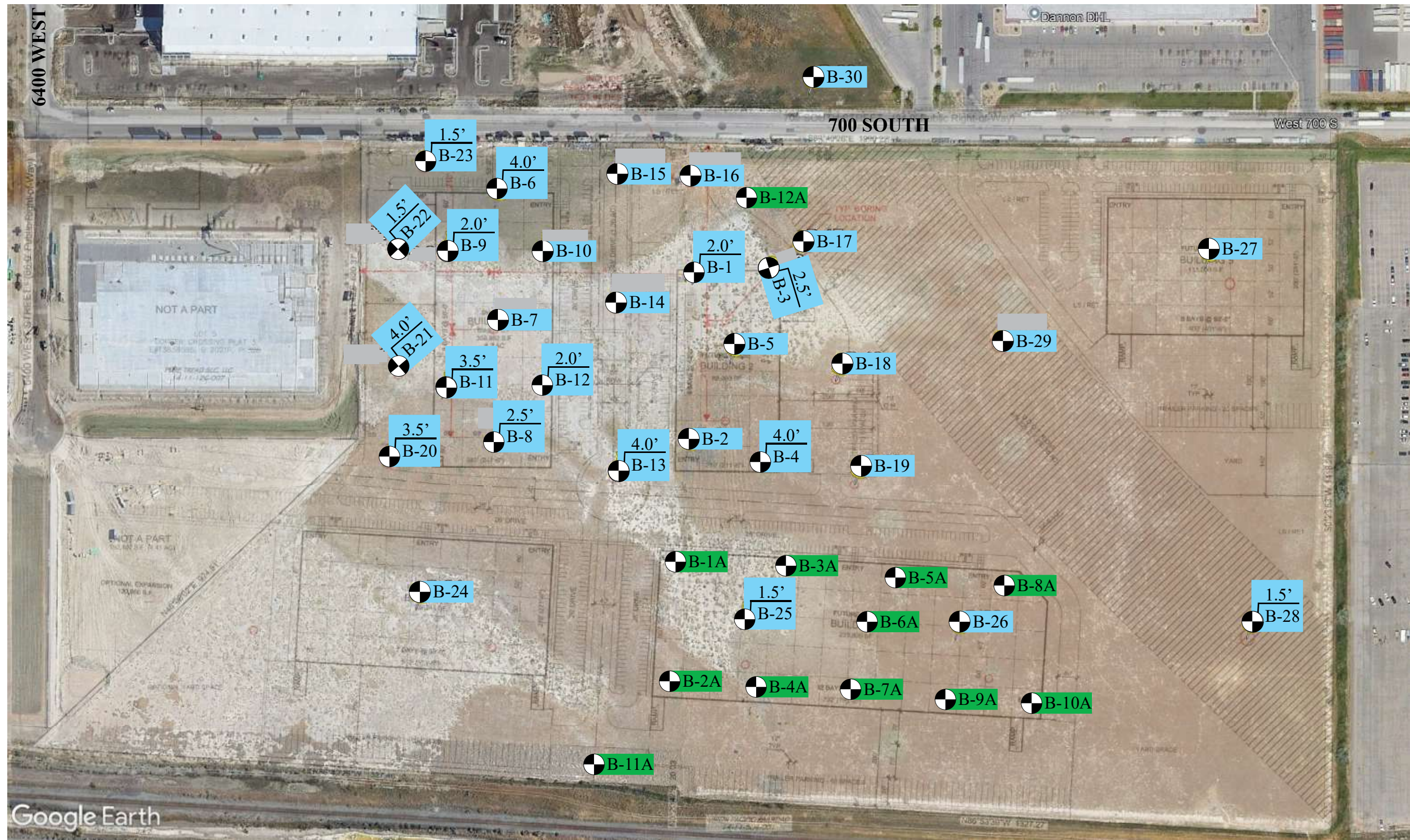
Figure	1,	Vicinity Map
Figure	2,	Site Plan
Figures	3A	through 3L, Boring Logs
Figure	4,	Key to Boring Log (USCS)

Addressee (email)



REFERENCE:
ALL TRAILS - NATIONAL GEOGRAPHIC TERRAIN
DATED 2025

FIGURE 1
VICINITY MAP
 GSH



REFERENCE:
ADAPTED FROM AERIAL PHOTOGRAPH
DOWNLOADED FROM GOOGLE EARTH
IMAGERY NOT DATED



KEY:

Depth of Non-engineered Fill (feet)
/ Boring Number (feet)

October 16, 2024 Report
Current Report



GSH

BORING LOG

Page: 1 of 1

BORING: B-1A

CLIENT: Property Reserve

PROJECT NUMBER: 3994-01A-25

PROJECT: 700 South PSP Office/Warehouse Distribution Facility - Building 3

DATE STARTED: 2/21/25

DATE FINISHED: 2/21/25

LOCATION: Southeast Corner of 700 and South 6400 West Street, Salt Lake City, Utah

GSH FIELD REP.: JC/LG

DRILLING METHOD/EQUIPMENT: 4-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 4.5' (2/27/25)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								moist medium stiff
	CL	SILTY CLAY with trace fine sand; light brown		9		27.1	95				
		grades brown/gray	5	7							saturated
		grades fine sandy clay; layers of fine sand up to 1" thick; gray/brown	10	10							
		grades silty clay; gray	15	15		27.1		62.8			very stiff
		End of Exploration at 16.5'. Installed 1.25" diameter slotted PVC pipe to 16.5'.									
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3A



GSH

BORING LOG

Page: 1 of 1

BORING: B-2A

CLIENT: Property Reserve

PROJECT NUMBER: 3994-01A-25

PROJECT: 700 South PSP Office/Warehouse Distribution Facility - Building 3

DATE STARTED: 2/21/25

DATE FINISHED: 2/21/25

LOCATION: Southeast Corner of 700 and South 6400 West Street, Salt Lake City, Utah

GSH FIELD REP.: JC/LG

DRILLING METHOD/EQUIPMENT: 4-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 7.0' (2/21/25)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
	CL	Ground Surface	0								moist stiff
		SILTY CLAY with major roots (topsoil) to 6"; dark brown		12							
			5	7							medium stiff
											saturated
		grades with fine sand; gray	10	16							stiff
		grades with trace coarse sand									
			15	7							medium stiff
		grades light brown									
		End of Exploration at 16.5'. No groundwater encountered at time of drilling. Installed 1.25" diameter slotted PVC pipe to 16.5'.									
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3B



GSH

BORING LOG

Page: 1 of 1

BORING: B-3A

CLIENT: Property Reserve

PROJECT NUMBER: 3994-01A-25

PROJECT: 700 South PSP Office/Warehouse Distribution Facility - Building 3

DATE STARTED: 2/21/25

DATE FINISHED: 2/21/25

LOCATION: Southeast Corner of 700 and South 6400 West Street, Salt Lake City, Utah

GSH FIELD REP.: JC/LG

DRILLING METHOD/EQUIPMENT: 4-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 10.0' (2/21/25)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
	CL	Ground Surface	0								moist stiff
		SILTY CLAY brown		13							
			5	9		27.4	98				medium stiff
		grades gray	10	6							saturated
		End of Exploration at 11.5'.									
			15								
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3C



GSH

BORING LOG

Page: 1 of 1

BORING: B-4A

CLIENT: Property Reserve

PROJECT NUMBER: 3994-01A-25

PROJECT: 700 South PSP Office/Warehouse Distribution Facility - Building 3

DATE STARTED: 2/21/25

DATE FINISHED: 2/21/25

LOCATION: Southeast Corner of 700 and South 6400 West Street, Salt Lake City, Utah

GSH FIELD REP.: JC/LG

DRILLING METHOD/EQUIPMENT: 4-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 6.0' (2/21/25)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								
	CL	SILTY CLAY with trace fine sand; major roots (topsoil) to 6"; dark brown		8							moist stiff
			5	13		29.3	93				saturated stiff
	CL	SILTY CLAY with trace fine sand; oxidation; gray	10	8							saturated medium stiff
		End of Exploration at 11.5'. No groundwater encountered at time of drilling.									
			15								
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3D



GSH

BORING LOG

Page: 1 of 1

BORING: B-5A

CLIENT: Property Reserve

PROJECT NUMBER: 3994-01A-25

PROJECT: 700 South PSP Office/Warehouse Distribution Facility - Building 3

DATE STARTED: 2/21/25

DATE FINISHED: 2/21/25

LOCATION: Southeast Corner of 700 and South 6400 West Street, Salt Lake City, Utah

GSH FIELD REP.: JC/LG

DRILLING METHOD/EQUIPMENT: 4-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 6.5' (2/27/25)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
	CL	Ground Surface	0								moist medium stiff
		SILTY CLAY brown		10		22.7	86				
		grades tan	5	4							soft
											saturated
		grades gray	10	9		32.7	87				medium stiff
		grades with trace fine sand; gray	15	24							very stiff
		End of Exploration at 16.5'. Installed 1.25" diameter slotted PVC pipe to 16.5'.									
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3E



GSH

BORING LOG

Page: 1 of 2

BORING: B-6A

CLIENT: Property Reserve

PROJECT NUMBER: 3994-01A-25

PROJECT: 700 South PSP Office/Warehouse Distribution Facility - Building 3

DATE STARTED: 2/21/25

DATE FINISHED: 2/21/25

LOCATION: Southeast Corner of 700 and South 6400 West Street, Salt Lake City, Utah

GSH FIELD REP.: JC/LG

DRILLING METHOD/EQUIPMENT: 4-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 7.0' (2/21/25)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
	CL	Ground Surface	0								very moist stiff
		SILTY CLAY with trace fine sand; major roots (topsoil) to 6"; brown grades with oxidation; brown/gray		11							medium stiff
			5	7					36	14	
		grades with layers of fine sand up to 1/2" thick; gray	10	7							stiff
		grades with layers of fine sandy clay and trace coarse sand up to 1/2" thick	15	14							very stiff
	SP/ SM	FINE TO COARSE SAND with some silt and trace clay; gray	25								saturated very dense

See Subsurface Conditions section in the report for additional information.

FIGURE 3F



GSH

BORING LOG

Page: 2 of 2

BORING: B-6A

CLIENT: Property Reserve

PROJECT NUMBER: 3994-01A-25

PROJECT: 700 South PSP Office/Warehouse Distribution Facility - Building 3

DATE STARTED: 2/21/25

DATE FINISHED: 2/21/25

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
			25								
			55								
		End of Exploration at 26.5'. Installed 1.25" diameter slotted PVC pipe to 26.5'.									
			30								
			35								
			40								
			45								
			50								

See Subsurface Conditions section in the report for additional information.

FIGURE 3F
(continued)



GSH

BORING LOG

Page: 1 of 1

BORING: B-7A

CLIENT: Property Reserve

PROJECT NUMBER: 3994-01A-25

PROJECT: 700 South PSP Office/Warehouse Distribution Facility - Building 3

DATE STARTED: 2/21/25

DATE FINISHED: 2/21/25

LOCATION: Southeast Corner of 700 and South 6400 West Street, Salt Lake City, Utah

GSH FIELD REP.: JC/LG

DRILLING METHOD/EQUIPMENT: 4-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 3.4' (2/27/25)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								moist stiff
	CL	SILTY CLAY with trace fine sand; major roots (topsoil) to 6"; dark brown grades brown		9							medium stiff saturated
		grades brown/gray	5	10							
			10	28							very stiff
	SM	SILTY FINE TO MEDIUM SAND with trace clay; gray									saturated medium dense
			15	33		23.8	94				
		End of Exploration at 16.5'. Installed 1.25" diameter slotted PVC pipe to 16.5'.									
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3G



GSH

BORING LOG

Page: 1 of 1

BORING: B-8A

CLIENT: Property Reserve

PROJECT NUMBER: 3994-01A-25

PROJECT: 700 South PSP Office/Warehouse Distribution Facility - Building 3

DATE STARTED: 2/21/25

DATE FINISHED: 2/21/25

LOCATION: Southeast Corner of 700 and South 6400 West Street, Salt Lake City, Utah

GSH FIELD REP.: JC/LG

DRILLING METHOD/EQUIPMENT: 4-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 6.5' (2/27/25)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
	CL	Ground Surface	0								moist medium stiff
		SILTY CLAY brown		9							
		grades red/brown	5	9		36.1	83				
											saturated
		grades gray/brown	10	5							
		End of Exploration at 11.5'. Installed 1.25" diameter slotted PVC pipe to 11.5'.									
			15								
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3H



GSH

BORING LOG

Page: 1 of 1

BORING: B-9A

CLIENT: Property Reserve

PROJECT NUMBER: 3994-01A-25

PROJECT: 700 South PSP Office/Warehouse Distribution Facility - Building 3

DATE STARTED: 2/21/25

DATE FINISHED: 2/21/25

LOCATION: Southeast Corner of 700 and South 6400 West Street, Salt Lake City, Utah

GSH FIELD REP.: JC/LG

DRILLING METHOD/EQUIPMENT: 4-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 6.2' (2/27/25)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
	CL	Ground Surface	0								moist stiff
		SILTY CLAY with trace fine sand; major roots (topsoil) to 6"; dark brown grades with trace coarse sand; oxidation; light gray		14		29.0	72				
			5	10							medium stiff saturated
		grades with trace fine sand; blue	10	10		31.7	89				
		End of Exploration at 11.5'. Installed 1.25" diameter slotted PVC pipe to 11.5'.	15								
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 31



GSH

BORING LOG

Page: 1 of 1

BORING: B-10A

CLIENT: Property Reserve

PROJECT NUMBER: 3994-01A-25

PROJECT: 700 South PSP Office/Warehouse Distribution Facility - Building 3

DATE STARTED: 2/21/25

DATE FINISHED: 2/21/25

LOCATION: Southeast Corner of 700 and South 6400 West Street, Salt Lake City, Utah

GSH FIELD REP.: JC/LG

DRILLING METHOD/EQUIPMENT: 4-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: 6.5' (2/27/25)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
	CL	Ground Surface	0			28.2		65.5			moist very stiff
		with trace fine sand; major roots (topsoil) to 6"; dark brown									
		grades with trace coarse sand; brown/gray									
			25								
			5								stiff
			13								saturated
		grades with trace fine gravel	10								medium stiff
		grades with fine sand; gray	15			29.1	93				stiff
		grades with layers of fine silt and sand up to 1/2" thick	20								
			21								
		End of Exploration at 22.5'. Installed 1.25" diameter slotted PVC pipe to 22.5'.	25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3J



GSH

BORING LOG

Page: 1 of 1

BORING: B-11A

CLIENT: Property Reserve

PROJECT NUMBER: 3994-01A-25

PROJECT: 700 South PSP Office/Warehouse Distribution Facility - Building 3

DATE STARTED: 2/21/25

DATE FINISHED: 2/21/25

LOCATION: Southeast Corner of 700 and South 6400 West Street, Salt Lake City, Utah

GSH FIELD REP.: JC/LG

DRILLING METHOD/EQUIPMENT: 4-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: Not Encountered (2/21/25)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								
	CL	SILTY CLAY with major roots (topsoil) to 6"; brown									moist stiff
		grades tan									
			5			36.6		89.4			
		End of Exploration at 5.5'. No groundwater encountered at time of drilling.									
			10								
			15								
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3K



GSH

BORING LOG

Page: 1 of 1

BORING: B-12A

CLIENT: Property Reserve

PROJECT NUMBER: 3994-01A-25

PROJECT: 700 South PSP Office/Warehouse Distribution Facility - Building 3

DATE STARTED: 2/21/25

DATE FINISHED: 2/21/25

LOCATION: Southeast Corner of 700 and South 6400 West Street, Salt Lake City, Utah

GSH FIELD REP.: JC/LG

DRILLING METHOD/EQUIPMENT: 4-1/4" ID Hollow-Stem Auger

HAMMER: Automatic

WEIGHT: 140 lbs

DROP: 30"

GROUNDWATER DEPTH: Not Encountered (2/21/25)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								
	CL	SILTY CLAY with trace fine sand; major roots (topsoil) to 6"; dark brown									moist stiff
		grades brown									
			5			39.4		95.7			
		End of Exploration at 5.5'. No groundwater encountered at time of drilling.									
			10								
			15								
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3L

CLIENT: Property Reserve
 PROJECT: 700 South PSP Office/Warehouse Distribution Facility - Building 3
 PROJECT NUMBER: 3994-01A-25

KEY TO BORING LOG

WATER LEVEL	USCS	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪	⑫
COLUMN DESCRIPTIONS											
①	Water Level: Depth to measured groundwater table. See symbol below.										
②	USCS: (Unified Soil Classification System) Description of soils encountered; typical symbols are explained below.										
③	Description: Description of material encountered; may include color, moisture, grain size, density/consistency,										
④	Depth (ft.): Depth in feet below the ground surface.										
⑤	Blow Count: Number of blows to advance sampler 12" beyond first 6", using a 140-lb hammer with 30" drop.										
⑥	Sample Symbol: Type of soil sample collected at depth interval shown; sampler symbols are explained below.										
⑦	Moisture (%): Water content of soil sample measured in laboratory; expressed as percentage of dryweight of										
⑧	Dry Density (pcf): The density of a soil measured in laboratory; expressed in pounds per cubic foot.										
⑨	% Passing 200: Fines content of soils sample passing a No. 200 sieve; expressed as a percentage.										
⑩	Liquid Limit (%): Water content at which a soil changes from plastic to liquid behavior.										
⑪	Plasticity Index (%): Range of water content at which a soil exhibits plastic properties.										
⑫	Remarks: Comments and observations regarding drilling or sampling made by driller or field personnel. May include other field and laboratory test results using the following abbreviations:										
			CEMENTATION:		MODIFIERS:		MOISTURE CONTENT (FIELD TEST):				
			Weakly: Crumbles or breaks with handling or slight finger pressure.		Trace <5%		Dry: Absence of moisture, dusty, dry to the touch.				
			Moderately: Crumbles or breaks with considerable finger pressure.		Some 5-12%		Moist: Damp but no visible water.				
			Strongly: Will not crumble or break with finger pressure.		With > 12%		Saturated: Visible water, usually soil below water table.				
Descriptions and stratum lines are interpretive; field descriptions may have been modified to reflect lab test results. Descriptions on the 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.											
UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)											
MAJOR DIVISIONS			USCS SYMBOLS	TYPICAL DESCRIPTIONS							
COARSE-GRAINED SOILS More than 50% of material is larger than No. 200 sieve size.	GRAVELS More than 50% of coarse fraction retained on No. 4 sieve.	CLEAN GRAVELS (little or no fines)	GW	Well-Graded Gravels, Gravel-Sand Mixtures, Little or No Fines							
		GRAVELS WITH FINES (appreciable amount of fines)	GP	Poorly-Graded Gravels, Gravel-Sand Mixtures, Little or No Fines							
			GM	Silty Gravels, Gravel-Sand-Silt Mixtures							
			GC	Clayey Gravels, Gravel-Sand-Clay Mixtures							
	SANDS More than 50% of coarse fraction passing through No. 4 sieve.	CLEAN SANDS (little or no fines)	SW	Well-Graded Sands, Gravelly Sands, Little or No Fines							
		SANDS WITH FINES (appreciable amount of fines)	SP	Poorly-Graded Sands, Gravelly Sands, Little or No Fines							
SM			Silty Sands, Sand-Silt Mixtures								
FINE-GRAINED SOILS More than 50% of material is smaller than No. 200 sieve size.	SILTS AND CLAYS Liquid Limit less than 50%		SC	Clayey Sands, Sand-Clay Mixtures							
		ML	Inorganic Silts and Very Fine Sands, Rock Flour, Silty or Clayey Fine Sands or Clayey Silts with Slight Plasticity								
		CL	Inorganic Clays of Low to Medium Plasticity, Gravelly Clays, Sandy Clays, Silty Clays, Lean Clays								
	SILTS AND CLAYS Liquid Limit greater than 50%	OL	Organic Silts and Organic Silty Clays of Low Plasticity								
		MH	Inorganic Silts, Micaceous or Diatomaceous Fine Sand or Silty Soils								
		CH	Inorganic Clays of High Plasticity, Fat Clays								
		OH	Organic Silts and Organic Clays of Medium to High Plasticity								
HIGHLY ORGANIC SOILS			PT	Peat, Humus, Swamp Soils with High Organic Contents							
DESCRIPTION	THICKNESS										
Seam	up to 1/8"										
Layer	1/8" to 12"										
	Bulk/Bag Sample										
	Standard Penetration Split Spoon Sampler										
	Rock Core										
	No Recovery										
	3.25" OD, 2.42" ID D&M Sampler										
	3.0" OD, 2.42" ID D&M Sampler										
	California Sampler										
	Thin Wall										

Note: Dual Symbols are used to indicate borderline soil classifications.

FIGURE 4



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SECTION 01 10 00

GENERAL REQUIREMENTS of the WORK

PART 1 - GENERAL

1.01 SUMMARY OF WORK

- A. This Section includes general conditions, provisions and requirements for Work covered by the Contract Documents and include the following:
1. Summary of Work
 2. Municipal Requirements
 3. General Requirement Provisions
 4. Payment Provisions
 5. Project Meetings
 6. Contractor Request for Information
 7. Submittals Procedures
 8. Product Substitutions
 9. Quality Control
 10. Progress Cleaning
 11. Cutting and Patching Procedures
 12. Project Closeout
- B. Scope of Work: Briefly, and without force and effect on the Contract Documents, the Work consists of construction of two, 1-story shell buildings of approximately 394,690 s.f. and related site and utility improvements. The Base Bid shall include performing and furnishing the Work required of the Contract Documents and providing the means, methods, equipment, techniques, construction procedures, design-build services, supervision, temporary power and utilities, and all labor and materials for construction of the Project.
- C. Project Identification:
1. Project Name: Building 1 & 4, 700 South
 2. Project Location: 752 and 804 South Street, Salt Lake City, Utah.
 3. Owner: Property Reserve
- D. Project Consultant Team:
1. Architect: Butler Design Group
 2. Structural Engineer: PK Associates
 3. Mechanical Engineer: Kraemer Consulting Engineers
 4. Electrical Engineer: Envision Engineering.
 5. Civil Engineer: CIR
 6. Landscape Architect: Laskin & Associates
 7. Geotechnical Engineer: GSH Geotechnical
- E. Contract Documents: The Contract Documents, dated February 25, 2026 and listed under Document 00 85 00 - Contract Drawing List, and indicate the scope of the Contract and related requirements and conditions to be anticipated in performing the Work.
1. Project Coordinator: Delia Martinez with Butler Design Group, may be contacted with questions regarding the Project Bid Documents.
- F. Bidder Prequalification: The Owner has pre-qualified and selected the General Contractor who will only accept bids from the selected Subcontractors.
1. Bid Instructions are available from the Project Bid Document Representative listed above.
 2. Bid Documents: Sub-bidders may obtain copies of the Bid Documents from the General Contractor in accordance with practices and reimbursement policies for that office. Sub-bidders are encouraged to review or obtain complete sets of Bid Documents in preparing bids. The Owner

and it's representatives assume no responsibility for errors or misinterpretations resulting from the use of incomplete sets of Documents.

- G. Owner-Furnished Items: The following Work has been or will be provided by the Owner under separate contract or agreement in addition to other items of Work where indicated as "NIC" or "Not in Contract".
1. Public Utility Coordination: Off-site water line taps to be performed by City forces.
 2. Soil Investigation: Geotechnical soil sampling has been performed and the results of which will be made available to the Contractor.

1.02 MUNICIPAL REGULATORY REQUIREMENTS

- A. Code Summary:
1. Floor Areas:
 - a. Building 1: 136,560 s.f.
 - b. Building 4: 258,130 s.f.
 2. Occupancy: S-1 and B.
 3. Construction Type: V-B
 4. Fire-Resistance Requirements:
 - a. Exterior Walls: None required 20' or greater from property line.
 - b. Structural Frame: 0 Hour.
 - c. Floor and Roof: 0 Hour.
- B. Code Regulations: The following applicable governing codes and standards will regulate and require conformance with the design and construction of the Project. Obtain copies and retain at the Project site to be available for reference by parties who have a reasonable need to reference:
1. International Building Code - 2021
 2. International Mechanical Code – 2021
 3. International Plumbing Code – 2021
 4. National Electrical Code – 2020
 5. International Energy Conservation Code – 2021
 6. International Fire Code – 2021, as amended.
 7. 2010 ADA Standards for Accessible Design
 8. Salt Lake City Code Amendments.
- C. Permits, Licenses, and Certificates: Maintain 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.
- D. Permits and Fees: The following fees and permits will be secured by the Owner:
1. Building Permit and Building Plan Review
 2. On-site Grading & Drainage Permit and Plan Review
 3. Off-site Paving and Off-site Utility Permits and Plan Review
 4. Water & Sewer Development Fees
 5. Development Impact Fees
 6. Electrical Utility Connection Fee
- E. The Contractor shall secure and pay for all other permits, licenses and inspections necessary for the proper and lawful completion of the Work. This includes, but is not limited to:
1. Haul Permits
 2. Temporary Street Closures
 3. Traffic Control Permits
 4. Temporary Construction Fencing
 5. Dust Control Permits
- F. Deferred Submittals: Submit copies of the following final submittals to authorities having jurisdiction (AHJ) with review stamp indicating review by the Architect or Engineer of Record.
1. Fire-Sprinkler System and Hydraulic Calculations
 2. Fire-Alarm System

3. Pre-fabricated Steel Joists and Calculations

- G. The Contractor shall comply with and give notices required by laws, ordinances, regulations and lawful orders bearing on the performance of the Work. If the Contractor performs Work knowing it to be contrary to such laws, ordinances and regulations, without written notice to the Owner, the Contractor shall assume the responsibility for fines, penalties and corrected work attributable thereto.
1. It is not the responsibility of the Contractor to make certain that the Contract Documents are in compliance with applicable laws, statutes, codes or building regulations. If the Contractor believes that any component of the Contract Documents are at variance therewith in any respect, he shall give prompt written notice to the Architect or Owner, as applicable.

1.03 GENERAL REQUIREMENT PROVISIONS

- A. Use of Premises: During the construction period the Contractor shall have full use of the premises for construction operations, including use of the site. The Contractor's use of the premises is limited only by the Owner's right to store materials or perform undetermined operations with its own forces or to employ separate contractors on portions of the project.
1. Hours of Operation shall be limited to the hours lawfully stipulated by the City of Salt Lake, Utah.
- B. General Provisions: General Conditions for the Work shall include the following:
1. Supervision Cost: Field supervisory personnel assigned to the Project, wherever employed in connection with the Work. Cost to include salaries, welfare and fringe benefits, including vacation, sick time, holidays, health, life and hospitalization insurance, company vehicles, unemployment and Worker's Compensation, Social Security and any other remuneration paid to Contractor's employees. For purposes of this Section, personnel include field engineers and general superintendents.
 2. Field Office: The cost of Contractor's field office and equipment, reproduction cost, office supplies, first-aid supplies, small tools and related items incurred in connection with the Work and as described under Section 01 50 00 – Temporary Facilities.
 3. Security: The cost of job site security, temporary fencing and security services.
 4. Refuse Disposal: The cost to provide and maintain containers, haul and dispose of debris resulting from the Work.
 5. First-aid: The cost to provide and maintain safety and first-aid supplies for general emergency purposes.
 6. Drinking Water: The cost to provide and maintain ice and drinking water for construction personnel.
 7. Fire-Protection: Cost to provide fire-protection measures to protect premises, including fire-extinguishers.
 8. Preconstruction Services: Cost to prepare and update project schedules and cost/budget projections during the period of construction.
 9. Utility Consumption: Cost of water, sewer, and electrical consumption during the period of construction.
 10. Safety Precautions: Cost to provide safety equipment and measures, including barriers, safety programs and implementation, construction signage and posted notices, lighting, safety-program personnel and inspections.
 11. Insurance: Cost of insurance in the amounts and coverages required under Base Bid General Conditions and Supplemental Conditions, for the period of construction. Include losses or expenses not compensated by insurance including deductibles for losses and expenses for which the General Contractor is responsible. Losses and expenses attributable to subcontractors shall be the responsibility of the subcontractor.
 12. Sanitary Facilities: The cost to provide and maintain temporary toilet facilities.
 13. Protection of Premises: Cost to protect existing facilities and adjacent property.
 14. Clean-up: Cost for labor and materials to clean areas affected by the Work and surrounding premises.
 15. Material Expediting: Cost of travel and related measures required to expedite materials and the delivery to the Project, relative to the general contractors work.
 16. Construction Signage: Cost for signage required for construction activities, traffic control, barricades and safety.

17. Fines: Fines from OSHA or other governing agencies related to the means and methods of performing the Work.
 18. Surveying: Cost of labor and materials to locate or verify location of items for conformance with the Work and coordination between general contractor's subcontractor.
 19. Construction Photos and Reports: Cost to provide monthly progress reports and construction photo documentation as required in Section 01 32 00 Construction Progress Documentation.
 20. Vertical Access: Cost to provide OSHA compliant temporary material/personnel stair scaffolding.
 21. Corrective Work: Cost to provide labor and materials required for coordination and correction of defective Work and Warranty/Guarantee obligations.
- C. Specification Format: The Specifications are organized into Divisions and Sections using the CSI Format numbering system.
1. Section Identification: The Specifications use section numbers and titles to help cross-referencing in the Contract Documents. Sections in the Project Manual are in numeric sequence; however, the sequence is incomplete. Consult the table of contents at the beginning of the Project Manual to determine numbers and names of sections in the Contract Documents.
 2. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
 3. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated and meanings shall be interpreted as appropriate. Singular words shall be interpreted as plural and plural words shall be interpreted as singular where applicable as the context indicates.

1.04 PAYMENT PROVISIONS

- A. Payment Application Form: The form of Application for Payment shall be similar to AIA Document G702, Application and Certification for Payment, supported by approved Continuation Sheet, indicating the scheduled value of major categories and subcontracts for the Work.
- B. Waivers of Mechanic's Lien: With each Application for Payment, submit partial waivers of mechanic's liens from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.
- C. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted.

1.05 PROJECT MEETINGS

- A. Pre-construction Conference: Schedule a pre-construction meeting before starting construction, at a time convenient to Owner and their representatives, but no later than 15 days after execution of the Agreement. Hold the conference at Project site or other agreed upon location.
- B. Progress Meetings: Conduct progress meetings at bi-monthly intervals at Project site. Coordinate dates of meetings with preparation of payment requests.
1. Attendees: In addition to representatives of Owner, Architect, each contractor, 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.
 2. Agenda: Review and correct or approve minutes of previous progress meeting. Review items of significance that could affect progress as appropriate to status of Project.
 3. Contractor's Construction Schedule: Update and review progress since the last meeting.
 4. Minutes: Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within 3 days of the meeting.
- C. Coordination Meetings: Conduct Project coordination meetings at intervals necessary to maintain the progress of the Work. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings.

1.06 CONTRACTOR'S REQUESTS FOR INFORMATION

- A. General: Contractor shall endeavor to keep the number of RFI's to a minimum and shall carefully study the Contract Documents to assure that the requested information is not available therein.
- B. RFI's shall be submitted by the Contractor and properly prepared to include a detailed written statement that indicates the specific Drawings or Specification in need of clarification and the nature of the clarification requested.
 - 1. Forms shall be completely filled in and attachments fully legible.
 - 2. RFI's shall be submitted and logged in numerical order.
 - 3. Each page of attachments to RFI's shall bear the RFI number and shall be consecutively numbered in chronological order.
 - 4. RFI's from subcontractors or material suppliers shall be submitted through, reviewed by, and signed by the Contractor prior to submittal to the Architect.
 - 5. RFI's shall be submitted by email.
- C. Contractor shall allow up to five (5) working days for response to RFI'S, unless review is required of multiple consultants, then the response period shall be seven (7) working days.
 - 1. RFI shall state requested date/time for response, however, this requested date/time for response is not a guarantee that the RFI will be answered by that date/time.

1.07 SUBMITTAL PROCEDURES

- A. General: Electronic copies in read-only format (PDF) of contract drawings will be provided for Contractor's use in preparing submittals. The following documents will be made available in Autocad format only:
 - 1. Grading and Drainage Site Plan
 - 2. Architectural Site Plan
 - 3. Architectural Floor Plans
 - 4. Architectural Ceiling Plans
 - 5. Architectural Building Elevations
 - 6. Structural Foundation Plans
 - 7. Structural Roof Framing Plans
- B. Procurement and Submittals Schedule: Prepare a master list of submittals with anticipated date of each initial submittal as it relates to sequence of construction activities.
 - 1. Allow (10) ten working days for initial review of each submittal. Schedule enough time for submittal review by Contractor prior to submission to Architect.
 - 2. Allow (5) five working days for subsequent review of resubmittals.
 - 3. Coordinate sequence of submittals with sequence of construction activities. Do not submit submittals more than sixty (60) days prior to when material is needed on jobsite.
- C. Transmittal: Package each submittal individually and appropriately for separate review. Number each transmittal in numerical sequence of date submitted. Architect will return submittals, without review, without sequential transmittal numbering.
 - 1. Where a submittal is not a specified or prior approved manufacturer or substitution, include Contractor's certification stating that information submitted complies with requirements of the Contract Documents and reason for substitution.
 - 2. Architect will discard submittals, without review, received from sources other than Contractor.
- D. Product Data Submittals: Submit in electronic format only, in a single submittal for each element of construction and type of product or equipment.
 - 1. If manufacturer's standard Product Data must be specifically modified to meet compliance with Project requirements, submit as Shop Drawings, not as Product Data.
 - 2. Mark each submittal to show which products and options are applicable to the Project, by location and specific specification paragraph reference.
- E. Shop Drawing Submittals: Submit in electronic format only, prepared with project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents.

1. Review each submittal for compliance with the Contract Documents. Note corrections, modifications, exceptions and field dimensions. Mark with review stamp indicating that the submittal has been reviewed, checked, and in Contractor's opinion in compliance with the Contract Documents. Architect will not review submittals that do not bear Contractor's review stamp and will return them without action.
 2. Review Stamp: Stamp each submittal with a review stamp that indicates Project name and location, submittal number, Specification Section title and number, name of reviewer and date of Contractor's review.
 3. The Architect's or Consultant's review of Contractor's submittals will be limited to an initial submittal review and one resubmittal review.
 4. Submittals with the Design Architect's or Consultant's logo, professional seal or title block will be returned without review.
 3. Submittal Review: Architect will review each submittal, make marks to indicate corrections or modifications required, and stamp and return each submittal with an action stamp to indicate action taken, as follows:
 - a. REVIEWED: That part of the Work covered by the submittal may proceed provided it complies with requirements of the Contract Documents.
 - b. REVIEWED AS NOTED: That part of the Work covered by the submittal may proceed provided it complies with notations or corrections on the submittal and requirements of the Contract Documents. Resubmittal is not required unless Contractor is at variance with comments noted.
 - c. REVISE AND RESUBMIT: Do not proceed with that part of the Work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise or prepare a new submittal in accordance with the notations; resubmit without delay.
 - d. REJECTED: That part of the Work indicated on the submittal does not comply with requirements of the Contract Documents or is insufficiently complete to review. Do not proceed with that part of the Work covered by the submittal, including purchasing, fabrication, delivery, or other activity.
- D. Information Only Submittals: Prepare and submit Informational Only Submittals required by other Specification Sections that are required for the Project Records. Informational Only Submittals will not be reviewed or returned to the Contractor and include the following:
1. Welding Certificates
 2. Material Test Reports
 3. Research/Evaluation Reports
 4. Structural Calculations
- F. Samples: Prepare full-size or in the size and manner specified, fully fabricated Samples, cured and finished as proposed to be installed in the Work. Prepare samples at the Project site to facilitate review and approval of qualities specified or variations anticipated. Include the following:
1. Comply with requirements in specific specification sections for mockups.
 2. Maintain approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Approved Samples will be used to determine final acceptance of construction associated with each sample.
- G. Construction Schedule: Prepare and submit a CPM network-diagram type schedule, broken down by Trade or Material, prior to the first submittal of shop drawings, and shall show proposed starting and completion dates for each Trade and activity for the Work.
1. Submit updated schedule with each Pay Application.
- H. Construction Photographs: Take a minimum of four, digital color photographs, and submit with each monthly Pay Application.

1.08 PRODUCT SUBSTITUTION REQUEST

- A. Substitution Requests: Submit electronic PDF copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
1. Documentation: Show compliance with requirements for substitutions and the following:

- a. Statement indicating why specified material or product cannot be provided.
 - b. List of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
 - c. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - d. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
 - e. Research/evaluation reports evidencing compliance with building code in effect for Project.
 - f. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.
 - g. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a request for substitution.
 - a. Form of Acceptance: Field Bulletin listing approved substitutions.
 3. The Contractor's inclusion of a product substitution as part of a Shop Drawing or Product Data submittal does not constitute a valid request for or approval of a substitution, regardless of whether the submittal is subsequently approved in whole or in part.

1.09 QUALITY CONTROL

- A. Owner Responsibilities: The Owner will employ and pay for the services of an independent agency to provide inspections, tests and similar quality control services specified to be performed by independent agencies and not by the Contractor.
 1. Costs for retesting and reinspecting construction that replaces or is necessitated by work that continues to fail to comply with the Contract Documents will be charged to Contractor.
- B. Contractor Responsibilities: The Contractor shall provide testing agency services required to meet the requirements of the Contract Documents and not otherwise provided by the Owner. The Contractor shall cooperate with agencies performing required inspections, tests and similar services and provide reasonable auxiliary services as requested. Notify the agency sufficiently in advance to permit assignment of personnel performing test and inspections so as not to delay the Work.
- C. General: Provide safe access to all work for inspectors and testing agency representatives to perform required testing and inspections, including but not limited to, fall protection, open-trench shoring, railings and structurally secure scaffolding.
- D. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
- E. Reports: Prepare and submit certified written reports that include the following:
 1. Project identification and entity responsible for performing tests and inspections.
 2. Dates and locations of samples and tests or inspections.
 3. Ambient conditions at time of sample taking and testing and inspecting.
 4. Indication of whether Work complies with the Contract Document requirements.
- F. General: The Testing Agencies and Special Inspectors employed by the Owner directly shall provide inspections and testing of the Work listed below and as required by the Municipal AHJ and as listed in other Sections of these Specifications.
 1. Section 03 30 00 – Cast-in-Place Concrete
 - a. Steel Reinforcing Inspection Reports.
 - b. Concrete Strength Test Reports.
 - c. Slab-on-Grade Flatness and Levelness Testing.
 - d. Floor Joint Sealant application Inspections.
 2. Section 03 47 00 – Site-Cast Tilt-Panel Concrete
 - a. Steel Reinforcing Inspection Reports (excluding lift insert embeds).
 - b. Concrete Strength Test Reports.

3. Section 04 22 00 – Concrete Unit Masonry
 - a. Steel Reinforcing Inspection Reports.
 - b. Grout Strength Test Reports.
 - c. Water-Penetration Test (building walls only) Reports.
4. Section 05 12 00 – Structural Steel Framing
 - a. Welded and bolted connections reports for shop fabrications requiring special inspections.
 - b. Welded Connection Inspection Reports.
 - c. Bolted Connection Inspection Reports.
5. Section 05 40 00 – Cold-Formed Metal Framing
 - a. Welding Inspection Reports.
 - b. Fastener Inspection Reports.
6. Section 07 54 00 – Membrane Roofing
 - a. Roof deck insulation board attachment Inspection Reports.
7. Section 08 42 00 – Aluminum Storefronts and Windowwalls
 - a. Water-Penetration Test Reports.
8. Section 31 20 00 – Earthwork
 - a. Soils/building pad Compaction Test Reports.
 - b. Utility trench backfill Inspection Reports.
 - c. Pavement subgrade preparation Compaction Test Reports.
 - d. Concrete pavement Steel Reinforcing Inspection Reports.
9. Section 31 31 20 – Soil Treatment
 - a. Termiticide application rate Test Reports.

1.10 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.
- B. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- C. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

1.11 CUTTING AND PATCHING

- A. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 3. Concrete and Masonry: Cut using machinery, such as an abrasive saw or a diamond-core drill.
 4. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 5. Proceed with patching after construction operations requiring cutting are complete.
- B. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections.

1. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - b. Restore damaged pipe covering to its original condition.
 2. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.
- C. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils and similar materials.

1.12 PROJECT CLOSEOUT

- A. Preliminary Procedures: Before requesting inspection for certification of Substantial Completion, submit written statement, to the Owner's Representative, that the Project or designated portion of the Project is substantially completed along with a list of items to be completed, if any, and the scheduled completion dates for those items.
1. The Owner's Representative will confirm the level of completion and, if appropriate, will request the Architect to prepare a Certificate of Substantial Completion with a punchlist of remaining items to be completed.
- B. Closeout Submittals: Before determining date of Substantial Completion, complete the following. List items below that will be incomplete at proposed Date of Substantial Completion.
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 of pending insurance changeover requirements.
 3. Submit specific and general warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 4. Prepare and submit Project Record Documents, operation and maintenance manuals, Final Completion construction photographs, damage or settlement surveys, property surveys, and similar final record information.
- C. Statement of Final Completion: Upon completion of all punchlists, the Contractor shall submit a written statement that:
1. All aspects of the Contract Documents have been complied with, including submission of specific warranties, certifications, guarantees, and maintenance agreements.
 2. Removal of construction cylinders and keys has been completed and permanent cylinders installed with receipt of key delivery to Owners personnel.
 3. All final cleaning has been completed.
- D. Final Closeout Procedures: Before requesting final inspection, complete the following:
1. Submit a Final Application for Payment.
 2. Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), reviewed by Architect.
- E. Record Drawings: Maintain and submit one set reproducible PDF prints of Contract Drawings and Shop Drawings that 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 prepare the marked-up Record Prints.
- F. O & M Manuals: Assemble a complete set of operation and maintenance data indicating the operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
- G. Warranties: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.
1. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents.

- H. Final Cleaning: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations. Employ experienced workers or professional cleaners for final cleaning, who understand and follow each material manufacturer's cleaning instructions.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

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SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes reinforced cast-in-place concrete for the following:
 - 1. Structural concrete footings and foundations.
 - 2. Interior slab-on-grade concrete.
 - 3. Steel reinforcement for cast-in-place concrete.
- B. Related Sections include the following:
 - 1. Section 03 47 00 for "Site-Cast Tilt-panel Concrete" for concrete tilt-panels.
 - 2. Section 04 22 00 for "Unit Masonry" for grouting of masonry walls.
 - 3. Section 07 26 26 for "Vapor Barriers" for under slab-on-grade sheet membranes.
 - 4. Section 32 13 13 for "Site Concrete Paving" for exterior concrete pavement and walks.

1.02 SLAB-ON-GRADE PERFORMANCE REQUIREMENTS

- A. Floor Flatness: Unless otherwise noted on drawings, all interior slabs-on-grade shall be constructed to an overall FF 50/FL 35 with a minimum local value of FF 25/FL 20. The overall area is a Test Section as defined in ASTM E 1155. The minimum local area is the area of a single placement.
- B. Floor Sealing: Interior slabs-on-grade indicated to receive applied densifier/sealer and prior to the start and application of products, the concrete subcontractor shall construct a test slab using the same equipment, tools and methods for finishing and curing the test slab as will be used for the remaining interior floor slab. Remaining application of densifier/sealer and polishing methods shall not commence until the owner has accepted the interior floor test slab.
- C. General Structural Requirements: Where more restrictive requirements are indicated on the Contract Drawings, these requirements shall supersede the requirements of this Section.

1.03 SUBMITTALS

- A. Product Data: For each type of manufactured material and proprietary product; including admixtures, curing compounds, patching compounds, and other materials to be installed in the Work.
- B. Steel Reinforcement Shop Drawings: Details of fabrication, bending, and placement, prepared according to ACI 315, "Details and Detailing of Concrete Reinforcement." Include material, grade, bar schedules, stirrup spacing and arrangement, and supports of concrete reinforcement. Include special reinforcement required for openings through concrete structures.
- C. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance with requirements indicated, based on comprehensive testing of proposed materials.
- D. Welding Certificates: Copies of certificates for welding procedures and personnel.
- E. Design Mixes: Submit mix designs at least three weeks prior to placement, for each type and class of concrete, in accordance with ACI 318 and ACI 302. Include alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances that warrant adjustments.
 - 1. Include test results that indicate admixtures, slump, shrinkage, fly-ash proportions and compressive strength.
 - 2. Include aggregate gradation test reports for each mix design.

- F. Certificates of Compliance: Signed by manufacturers certifying that each of the following items complies with requirements:
1. Cementitious materials, admixtures, recycled materials and aggregates.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed concrete Work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment and certified according to the National Ready Mixed Concrete Association's Certification of Ready Mixed Concrete Production Facilities.
- C. Testing Agency Qualifications: An independent testing agency, engaged by the Owner, qualified according to ASTM C 1077 and ASTM E 329 to conduct the testing indicated. Retesting of rejected or nonconforming work and materials shall be at Contractor's expense.
- D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, each aggregate from one source, and each admixture from the same manufacturer.
- E. Welding: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code-- Reinforcing Steel."
- F. Codes and Standards: Comply with applicable provisions of the following codes, specifications and standards, unless more stringent provisions are indicated or specified:
1. 2021 International Building Code.
 2. ACI 301, "Specification for Structural Concrete."
 3. ACI 302.1R, "Guide for Concrete Floor and Slab Construction".
 4. ACI 306R, "Guide to Cold Weather Concreting."
 5. ACI 305R, "Guide to Hot Weather Concreting."
 6. ACI 318, "Building Code Requirements for Structural Concrete".
 7. ASTM A 1094, "Standard Specification for Continuous Hot-Dip Galvanized Steel Bars for Concrete Reinforcement."
 8. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
 9. ASTM C 39, "Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens".
 10. ASTM C 42, "Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Concrete".
 11. ASTM C 143, "Standard Test Method for Slump of Hydraulic Concrete".
 12. ASTM C 172, "Standard Practice for Sampling Freshly Mixed Concrete".
 13. ASTM C 173, "Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method".
 14. ASTM C 231, "Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method".
 15. ASTM C 618, "Specifications for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete".
 16. ASTM E 1155, "Standard Test Method for Determining Floor Flatness and Levelness Using the F-Number System".
 17. Concrete Reinforcing Steel Institute (CRSI) "Manual of Standard Practice".

PART 2 - PRODUCTS

2.01 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practical sizes to minimize number of joints.
 - 1. Exterior-grade plywood panels, rosin-coated plywood, metal, or other approved panel materials.
- B. Rough-Formed Finished Concrete (below-grade only): Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Forms for Cylindrical Columns, Pedestals, and Pole-Base Supports: Metal, glass-fiber-reinforced plastic, or paper-fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient thickness to resist wet concrete load deformation.
- D. Form Ties: Factory-fabricated, adjustable-length, removable or snap-off non-corrosive metal or reinforced plastic form ties designed to prevent form deflection and to prevent spalling of concrete on removal.
- E. Chamfer Strips: Solid wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum. Strips cut from wood sheet material are not acceptable.
- F. Form-Release Agent: Commercially formulated compound with a maximum VOC content of 350 g/L, that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces or finishing operations.

2.02 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615, Grade 60, deformed, plain finish.
- B. Low-Alloy-Steel Welded Bars; ASTM A 706, Grade 60, deformed, plain finish.
- C. Plain-Steel Welded Wire Fabric: ASTM A 1064, fabricated from as-drawn steel wire into flat sheets.
- D. Galvanized Plain-Steel Welded Wire Fabric: ASTM A 1064, fabricated from steel wire into flat sheets.
- E. Deformed-Steel Welded Wire Fabric: ASTM A 1064, flat sheet.
- F. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.03 REINFORCEMENT ACCESSORIES

- A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing and supporting reinforcing bars and welded wire fabric in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete and as follows:
 - 1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected or CRSI Class 2 stainless-steel bar supports.
 - 2. For slabs-on-grade, use supports with sand-plates where base material or vapor-barrier membrane will not support chair legs.
- B. Joint Dowel Bars: Plain-steel bars, ASTM A 615, Grade 60.
- C. Dowel Baskets: In accordance with ACI 302.1R-04. Acceptable manufacturers include:
 - a. Double-Tapered Basket; Green Streak Group, Inc.
 - b. PD3 Basket; PNA Construction Technologies.

2.04 CONCRETE MATERIALS

- A. Portland Cement:

1. Concrete which is not exposed to soils with severe sulfate content: ASTM C 150, Type I or Type II, alkali content not to exceed 0.6 percent.
 2. Concrete which is exposed to soils with severe sulfate content: ASTM C 150, Type V.
 3. Single-Source: Provide cementitious material of the same brand from the same manufacturer's plant for all cast-in-place concrete throughout the Project.
- B. Fly Ash: ASTM C 618, Class C, proportioned in accordance with ACI 232-4.1, meeting the following:
1. Conform to the requirements of the current edition of ASTM C 618, as follows:
 - a. ASTM C 618, Table 1 Chemical Requirements and Table 1A Supplementary Optional Chemical Requirements.
 - b. ASTM C 618, Table 2 Physical Requirements and Table 2A Supplementary Optional Physical Requirements in the following areas:
 - 1) Effectiveness in Controlling Alkali-Silica Reaction.
 - 2) Effectiveness in Contributing to Sulfate Resistance, Procedure A.
 2. Combined fly ash, silica fume or other pozzolans shall not exceed the following percentages of cement by weight and have a replacement factor of 1.2 relative to cement replaced unless approved otherwise by Structural Engineer of Record:
 - a. Class A Concrete: 25 percent.
 - b. Class B Concrete: Not permitted.
 - c. Class C Concrete: 15 percent.
 - d. Class D Concrete: 25 percent.
- C. Normal-Weight Aggregate: ASTM C 33, uniformly graded, not less than Class 1N coarse aggregate, free of substances with deleterious reactivity to alkali in cement. Provide aggregates from a single source for Class B and Class C concrete mixes.
1. Nominal Maximum Course Aggregate Size: 1 1/2 inches, 3-sided angular.
 2. Fine Aggregate: Clean, washed, sand and gravel, from same source as coarse aggregate.
- D. Water: Potable.

2.05 CONCRETE MIXES

- A. Prepare design mixes for each type and strength of concrete determined by a qualified independent testing agency for preparing and reporting proposed mix designs by either laboratory trial mix basis or field test data basis, as follows:
1. Proportion normal-weight concrete according to ACI 211.1 and ACI 301.
- B. Structural Concrete: Proportion mix designs to produce strength(s) as noted on Drawings, with the following properties:
1. Class A: Normal weight concrete; for use in walls, columns, suspended slabs and all concrete except as noted below.
 - a. Minimum compressive strength (28 Days): 4000 psi.
 - b. Maximum coarse aggregate size: 1 inch.
 - c. Maximum water percentage to cementitious materials ratio by weight: 0.50.
 - d. Maximum slump: 4 inches.
 2. Class B: Normal weight concrete; for use in concrete exposed to weather
 - a. Minimum compressive strength (28 Days): 4000 psi.
 - b. Maximum coarse aggregate size: 1 inch.
 - c. Maximum water percentage to cementitious materials ratio by weight: 0.50.
 - d. Maximum slump: 5 inches.
 3. Class C: Normal weight concrete; for use in interior slabs-on-grade.
 - a. Minimum compressive strength (28 Days): 4000 psi.
 - b. Maximum coarse aggregate size: 1-1/2 inch.
 - c. Maximum water percentage to cementitious materials ratio by weight: 0.48.
 - d. Maximum slump: 5 inches.
 4. Class D: Normal weight concrete; for use in footings and foundations.
 - a. Minimum compressive strength (28 Days): 3000 psi.U.N.O.
 - b. Maximum coarse aggregate size: 1-1/2 inch.
 - c. Maximum water percentage to cementitious materials ratio by weight: 0.52.
 - d. Maximum slump: 6 inches.

- C. Adjustment to Concrete Mixes: Mix design adjustments may be requested by General Contractor when characteristics of materials, job conditions, weather, test results or other circumstances warrant; at no additional cost to Owner and as accepted by Owner. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Owner before using in Work. Both the concrete supplier and the concrete subcontractor shall guarantee that the proposed concrete mix design will produce a concrete which will meet the specifications for this Project.
 - 1. Contractor shall verify that the workability, finishability and setting times are appropriate for slab installations.
 - 2. Placement shall be made by chute directly from the concrete trucks. If pumping of the concrete is contemplated for any special locations, the proportions established above shall not be altered to suit the capabilities of the pumping equipment.

2.06 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94 and ASTM C 1116, and furnish batch ticket information.
 - 1. When air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
 - 2. For dry-batch deliveries, ensure a minimum of 100 mixer-barrel revolutions, during transportation from central plant to site.
- B. Provide batch ticket for each batch discharged and used in the work, indicating project identification name and number, date, mix type, mix time, quantity, and amount of water added. The batch ticket shall state the quantity of water or ice that may be added on the job site, if any.

2.07 ADMIXTURES

- A. General: Admixtures certified by manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material and compatible with other admixtures and cementitious materials. Do not use admixtures containing fly ash or slag.
- B. Water-Reducing Admixture: ASTM C 494, Type A or Type F (mid-range water reducer).
- C. Water-Reducing and Retarding Admixture: ASTM C 494, Type A or Type D.
- D. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494, Type A or Type F.

2.08 FLOOR AND SLAB TREATMENTS

- A. Penetrating Liquid Densifier/Sealer Floor Treatment: Chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; colorless; that penetrates, hardens, and densifies concrete surfaces. Minimum 20% solids content. Acceptable products include:
 - 1. Ashford Formula; Curecrete Chemical Co., Inc.
 - 2. Euco Diamond Hard; Euclid Chemical Co.
 - 3. Seal Hard; L&M Construction Chemicals, Inc.

2.09 CURING MATERIALS

- A. Flooring Compatibility: Obtain written documentation from flooring contractor(s) that curing compound is compatible with flooring materials and adhesives that will be applied to floor surfaces prior to delivery of curing compound to jobsite.
 - 1. Do not use where slabs are scheduled to receive penetrating sealer/hardener or thin-set tile applications.
- B. Liquid-Membrane Curing Compound: Clear, water-based, self-dissipating V.O.C. compliant, resin-based type: ASTM C 309, Type 1, Class B. Acceptable products include:
 - 1. Vocomp 20; W. R. Meadows, Inc.

2. Kurez DR VOX; Euclid Chemical Company.
 3. L&M Cure R; L&M Construction Chemicals, Inc.
- C. Liquid-Membrane Curing and Sealing Compound: Clear, water-based, acrylic copolymer type: ASTM C 1315, Type 1, Class A or Class B, 25% solids content. Acceptable products include:
1. Vocomp 25; W. R. Meadows, Inc.
 2. Super Aqua Cure VOX; Euclid Chemical Company.
 3. Dress & Seal WB 25; L&M Construction Chemicals, Inc.
 4. Atlas Quantum-Cure; Atlas Tech Products
- D. Evaporation Reducer: Spray-applied, waterborne, monomolecular film forming, for application to fresh concrete to aid in the prevention of rapid moisture loss during the finishing operations. Acceptable products include:
1. EucoBar; Euclid Chemical Company.
 2. E-CON; L&M Construction Chemicals, Inc.
 3. Confilm-MasterKure ER 50; BASF Construction Chemicals.

2.10 RELATED MATERIALS

- A. Vapor Barrier: Provide vapor barrier membrane in accordance with Section 07 26 26 "Under-Slab Vapor Barriers", under floor slab areas to receive floor coverings or otherwise indicated on Drawings. Polyethylene sheet film shall not be permitted under interior slabs.
- B. Joint-Filler Strips: At slabs abutting vertical elements, ASTM D 1751, cellulosic-foam; 1/2-inch thick. Acceptable Products include:
1. Ceramar; W. R. Meadows, Inc.
 2. Normaflex; Nomaco.
- C. Reglet Keys: Fabricate reglets of not less than 0.0217-inch- thick galvanized steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.
- D. Semi-Rigid Joint Filler: Two-component, semi-rigid, 100 percent solids, polyurethane resin with a minimum Shore "A" hardness of 90 per ASTM D 2240. Acceptable Products include:
1. Edge-Pro 90; Metzger McGuire, Inc.
 2. Qwickjoint UVR 95; Euclid Chemical Company.
 3. MasterSeal CR 100; BASF Company.
- E. 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 to suit requirements, and as follows:
1. Types I and II, non-load bearing, for bonding freshly hardened concrete to hardened concrete.
- F. Non-Shrink Grout: ASTM C 1107, Grade B, 7,000 psi, pre-packaged, non-metallic, non-staining, non-shrink grout. Acceptable products include:
1. Euco N-S Grout; Euclid Chemical Company.
 2. Masterflow 555; BASF Construction Chemicals.
 3. SikaGrout; Sika Corporation, Inc.
- G. Self-Leveling Underlayment: ASTM C 109, 4,000 psi, cementitious copolymer, compatible with floor sealers. Acceptable products include:
1. Flo-Top; Euclid Chemical Company.
 2. Ardex K-15 Self-Leveling Underlayment; Ardex Engineered Cements.
 3. Levelayer I; Dayton Superior Corporation.

2.11 REPAIR MATERIALS

- A. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene. Combine 1 part portland cement to 1-1/2 parts fine sand in a 50:50 mixture with admixture to a thick paste consistency.

- B. Crack Repair Filler: Two-component, low-viscosity, epoxy urethane resin with a minimum compressive strength of 8000 psi per ASTM D 695. Acceptable Products include:
 - 1. Sikadur 35; Sika Corporation, Inc.
- C. Tilt-Panel Formboard Fastener Filler: See Section 03 47 00 – Site-cast Tilt-Panel Concrete for slab-on-grade patching materials related to tilt-panel formboard casting.
- D. Patching Mortar: Dry-pack mix consisting of polymerized portland cement and fine aggregate passing No. 16 sieve, using only enough water for handling and placing. Acceptable products include:
 - 1. Thorite 400; BASF Construction Chemicals, LLC.
 - 2. Patchcrete; Lyons Manufacturing, Inc.
 - 3. Ardex CP; Ardex Engineered Cements.

PART 3 - EXECUTION

3.01 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, dynamic loads, and construction loads that may be applied, until concrete structure can support such loads.
- B. Chamfer exterior corners and edges of permanently exposed concrete.
- C. Form openings, chases, offsets, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- D. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.
- E. Form Liners: Where special cast-in-place wall finishes are indicated to be produced from form liners, securely place form liner panels in pattern indicated, aligning ribs or pattern of end panels tightly and uniformly to reduce the appearance of panel joints or mortar leakage.
- F. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

3.02 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use approved Setting Drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.03 SLAB-ON-GRADE PREPARATION

- A. Coordinate electrical and plumbing work to insure all under-slab sleeves, anchors, conduit, floor boxes, pipes, fittings and other items are installed to correct location, elevation and slope.
- B. Install crushed stone sub-base to the minimum compacted thickness as indicated on Drawings. Prior to installation, verify proper sub-grade elevations to assure that the minimum thickness of stone sub-base can be achieved.
- C. Compact sub-grade, sub-base and pipe trench areas to minimum 95% Modified Proctor density in accordance with ASTM D 1557.

3.04 VAPOR BARRIERS

- A. General: Place vapor barrier membrane in accordance with Section 07 26 26 for "Vapor Barriers" for under slab-on-grade vapor barrier membranes.
 - 1. Lap and seal seams and penetrations as recommended by membrane manufacturer.
 - 2. Do not cover membrane with sand cushion. Concrete shall be placed directly in contact with membrane.

3.05 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.
 - 1. Where vapor barriers are required, do not cut or puncture vapor barrier. Repair damage and reseal vapor barrier in a manner acceptable to membrane manufacturer before placing concrete.
 - 2. Install all anchors, ties, chairs and other supports as requested to insure reinforcing being held at proper locations. All reinforcing shall be wired in place using annealed wire. Wood or clay brick chairs are not be acceptable.
 - 3. Welded wire fabric mesh shall be lapped a minimum of 6 inches at side laps and secured with tie wires no more than 4 feet on center.
- B. Clean reinforcement of loose rust and mill scale and other foreign materials.
- C. Accurately position, support, and securely tie reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
- D. Install welded wire fabric in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Tie overlaps with wire.

3.06 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete. Where special floor finishes, such as ceramic tile or terrazzo, require alignment of flooring joints with concrete joints, coordinate location of concrete joints with approved flooring layout submittals.
- B. Construction (Cold) Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 - 1. Space joints and continue reinforcement across construction joints and closure pours as indicated. Do not continue reinforcement through sides of column isolation closure pours, unless specifically indicated otherwise.
 - 2. Locate slab-on-grade construction joints to align with column grid lines or around largest single slab pour whichever is less. Form slab edges to provide 1/2-inch wide joint, full depth of slab.
 - 3. Space vertical joints in cast-in-place walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
- C. Contraction (Control) Joints in Floor Slabs: Form weakened-plane contraction joints, sectioning concrete into areas as indicated or no greater than 15 feet apart in any direction. Construct contraction joints as follows:
 - 1. Sawed Joints: Form contraction joints with power saws equipped with a "Soff-Cut" diamond blade and skid plate. Joints shall be cut as soon as the slab will support the weight of the saw and operator and when cutting action will not tear, abrade, or otherwise damage the concrete surface. Cuts must be made before concrete develops random contraction cracks and no later than four (4) hours after completion of finishing operations.
 - 2. Cut 1/8-inch wide joints, cutting a minimum of 1-1/2" inch deep or one-third of concrete slab thickness (whichever is deeper) into interior floor slab. Chalk lines and concrete dust shall be removed completely and immediately after cutting operation.
- D. Isolation Joints in Floor Slabs: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as foundation walls, grade beams, and other locations as indicated.
 - 1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.

2. Wall-to-Slab Joints: Where floor slabs abut vertical wall elements, provide 1/2-inch wide expansion joint of depth suitable for placement of sealant.
- E. Dowel Joints: Install dowel sleeves and dowels or dowel-bar basket assemblies at joints where indicated. Use dowel sleeves to prevent concrete bonding to one side of joint.

3.07 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete, securely braced and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement, unless approved by Testing Laboratory.
- C. Deposit vertical concrete in forms in horizontal lifts in a manner to avoid inclined construction joints. Place each layer while preceding layer is still plastic, to avoid cold joints.
 1. Consolidate placed concrete with mechanical vibrating equipment. Use equipment and procedures for consolidating concrete recommended by ACI 309R.
- D. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
 1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 2. Maintain reinforcement in position on chairs during concrete placement.
 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 4. Slope surfaces uniformly to drains where required.
- E. Hot-Weather Placement: Place concrete according to recommendations in ACI 305R 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.

3.08 FINISHING FORMED VERTICAL SURFACES

- A. Grout-Rubbed Finish: Where indicated on Drawings, provide grout-rubbed finish on concrete surfaces that receive smooth-formed finish, except do not apply grout-rubbed finish to integral-color concrete surfaces or surfaces scheduled to receive exposed aggregate finish.
 1. Combine 1 part portland cement to 1 part fine sand in a 50:50 mixture with acrylic bonding admixture and water to a stiff grout consistency. Blend standard portland cement with white portland cement in trial applications until dry grout matches adjacent surface finish and color.
 2. Dampen concrete surface, apply grout to coat surface and fill pin-holes. Remove excess grout by scrapping and rubbing with rubber float to feather and blend to a uniform finish and texture. Keep surface damp for at least 36 hours after final rub finishing.
- B. Curbs and Equipment Pads: Remove forms while concrete is still wet but stiff enough to support weight without deformation. Steel-trowel vertical surface edges to a hard, dense finish with corners tooled to slightly round profile. Where broom finish is indicated on slab finish, apply same finish techniques to vertical surfaces to match final slab finish.

3.09 FINISHING FLOORS AND SLABS

- A. General: Comply with recommendations in ACI 302.1R for screeding, restraightening, and finishing operations for concrete surfaces and as necessary to meet the FF and FL requirements. A minimum of one (1) finisher or finishing supervisor shall be a certified ACI Flatwork Finishing Technician and shall be present during all slab finishing operations.

1. Use laser screeds, vibratory screeds, 10-foot highway straightedges and bull floats to initiate screeding and floating process to form a uniform and open-textured surface plane before excess moisture or bleed water appears on the surface.
 2. Remove excess water before starting floating operations.
 3. Do not further disturb surfaces before starting finishing operations. Do not wet concrete surfaces during finishing operations.
- B. Interior Floor Slab Tolerances:
1. Comply with ACI 117, "Specifications for Tolerances for Concrete Construction and Materials." Interior slab-on-grade concrete floors shall be constructed as follows:
 - a. Warehouse Areas (Class 5 – Random Traffic):
 - 1) Specified Overall Value (SOV): FF 50/FL 35
 - 2) Minimum Local Value (MLV): FF 25/FL 20.
 2. Slabs shall be measured in accordance with ASTM E 1155 within 72 hours after finishing. The overall area is a Test Section as defined in ASTM E 1155. The minimum local area is the area of a single placement.
 3. Acceptance of floor slabs for flatness and levelness:
 - a. Owner's testing agency will conduct flatness and levelness testing.
 - b. In the event that FF or FL for a placement is below the minimum local value, the contractor, at the direction of the Owner's representative, will do one of the following:
 - 1) Rebate to the Owner an amount as defined in the Contract or other value acceptable to Owner.
- C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Cut down high spots, and fill low spots. Repeat float passes until surface is left with a uniform, smooth, granular texture.
1. Apply float finish to surfaces indicated and to floor and slab surfaces to be covered with thick-set tile.
- D. Hard Steel-Troweled Finish: Continue highway straightedge floating operations until specified floor tolerances are achieved.
1. Finish surfaces with power-operated troweling machine with adjustable Teflon-coated steel trowel blades not less than 45" in diameter. Hard trowel surface a minimum of three (3) trowelings, producing an acceptable smooth surface. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Care shall be taken not to overwork the surface.
 2. Apply steel-trowel finish to all floor slab surfaces unless otherwise indicated.
- E. Trowel and Broom Finish: Where scheduled to receive thin-set tile applications, apply trowel finish and immediately follow with light-broom finish to slightly scarify surface to accept thin-set mortar or adhesives.
- F. Non-Slip Broom finish: Apply a medium-broom finish to exterior walks, stoops and platforms, unless otherwise indicated. Remove edge-tool marks at control joints by lightly brooming after final contour of joint profile is achieved.

3.10 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings, greater than 1/4 inch in diameter, left in concrete exposed to view, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction.

3.11 INTERIOR CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive hot temperatures. Comply with recommendations in ACI 305R for hot-weather protection during curing.
1. Protect interior slabs from excessive moisture loss before and during finishing operations with evaporation-retarding materials, applied beforehand or power troweling. Apply retarder to maintain moist surface conditions and to minimize plastic dry shrinkage cracking of the concrete

surface of freshly placed concrete in accordance with manufacturer's instructions per Article 2.09, Section E.

- B. Interior Slabs (dissipating membrane cure): At Contractor's option, interior concrete slabs shall be cured using a reduced odor, dissipating liquid membrane forming curing compound that is formulated from hydrocarbon resins. The dissipating liquid membrane forming curing compound shall meet the requirements of ASTM C-309 with a maximum V.O.C. content of 450g/l.
1. Do not apply where slabs are scheduled to receive floor finishes.
 2. Apply curing compound the same day of concrete pour and after final finishing operations have been completed, including saw-cutting of control joints.
 3. Spray-apply at a minimum rate of 400 s.f. per gallon and lightly broom material into surface of concrete. Apply curing compound prior to any other chemical treatment of concrete surface.
 4. Curing compound shall be completely removed from the interior concrete floor slab. Allow interior concrete slabs to air dry for at least twelve (12) hours prior to applying liquid densifier/sealers.
 5. The cost associated with the removal of dissipating liquid membrane forming curing compound from the interior concrete floor slab shall be the responsibility of the Contractor.
- C. Formed Surfaces: For formed, vertical concrete and suspended slabs, keep forms in place for 7 days. Where removal of forms are required before 7-day cure period, cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces with fog-spray application of water for remaining cure period.

3.12 LIQUID DENSIFIER/SEALER APPLICATION

- A. General: Apply liquid densifier/sealer to all interior slab-on-grade concrete slabs. If the liquid densifier/sealer is to be applied as a curing compound within 24 hours of concrete finishing or saw-cutting operations, consult liquid densifier/sealer manufacturer for application procedures. Coordinate application of any tilt-panel bondbreaker compounds with liquid densifier/sealer manufacturer so as not to compromise the penetration of the liquid densifier/sealer into the concrete slab.
- B. Floor Slab Cleaning: Prior to application of liquid densifier/sealer, inspect and thoroughly clean slab with auto scrubber to ensure that it is clean and free of curing or sealing compounds, tilt-panel bondbreakers, dust, oils or other contaminants that might inhibit the proper application and penetration of the liquid densifier/sealer.
1. Scrape the floor using a scraper as required to remove remaining saw-cut residue, form glue, texture overspray, oil drippings, and other built-up material on the surface. Use a non-acidic cleaner compatible with the liquid densifier/sealer.
 2. Scrub the entire floor with an automatic scrubber capable of a minimum of 80 psi water pressure, equipped with a combination or light grit rotary brushes and a neutral pH cleaning detergent that is compatible with the liquid densifier/sealer. Remove liquid as the floor is scrubbed.
 3. Immediately following cleaning process, allow floor slab to air-dry for twelve (12) hours, prior to applying the first application of liquid densifier/sealer.
- C. Application: Application of liquid densifier/sealer shall be performed by an approved applicator of the liquid densifier/sealer manufacturer. The approved applicator for the initial application shall be the same as for the polishing process and any additional application of liquid densifier/sealer in accordance with manufacturer's instructions.
1. Within twenty-four hours after air-dry period, apply liquid densifier/sealer with low-pressure sprayer or squeegee at a minimum coverage rate 200 sq. ft. per gallon keeping the slab surface wet for a minimum of 30 minutes. Work the material into the slab surface with a soft-bristle broom or auto-scrubber.
 2. In hot-weather conditions, should areas become dry during 30 minute soak-in period, apply additional liquid densifier/sealer to maintain a wet surface for the full soak-in period.
 3. After the liquid densifier/sealer has been absorbed into the slab surface, flush all finished surfaces with water and broom or squeegee excess liquid densifier/sealer material, completely removing excess material from slab surfaces.
 4. Mechanically remove excess liquid densifier/sealer that has been allowed to dry. Consult liquid densifier/sealer manufacturer for removal procedures.

- D. Second Application: The polishing process and additional application of liquid densifier/sealer shall take place as late in the project sequence as practical, but prior to construction completion.
1. Liquid Densifier/Sealer: Provide a second application of liquid penetrating/sealer at a minimum coverage 1000 sq. ft. per gallon. Buff floor surface with one pass of buffing pads to provide a hard polish appearance, to attain an average gloss reading of not less than 30. Completely clean floor of any remaining residue.

3.13 JOINT FILLERS

- A. Joint Filler Installation: Comply with recommendations in ACI 302 for use of joint fillers as applicable to materials, applications, and conditions indicated in accordance with manufacturer's instructions per Article 2.10, Section D. Install joint filler as late in the project sequence as practical, but no sooner than 90 days after slab pour.
1. Cleaning: The joint must be clean and dry. All oil, dirt, debris, paint, and any other material that may be a bond breaker must be removed from the joint surfaces, prior to joint filler application.
 2. Mixing: The specified joint filler is a two part product requiring machine mixing and placing. Premix Part A and B separately before using. Follow pump manufacturer's equipment instructions.
 3. Placement: Joint filler shall be placed full depth. No backer rod is allowed. Joints should be overfilled and shaved even with the surrounding joint edge giving the floor joints a flat, smooth appearance. Shaving of excess joint filler can occur approximately 30 minutes after filling of joints.
 4. Depth of Joint Filler (Sawcuts): For proper load transfer, joints must be filled full depth to bottom of sawcut, but in no case shall the joint filler be any less than 1-1/4" deep in the joint.
 5. Depth of Joint Filler (Construction Joints): At construction joints, backer rod shall be permissible, but shall be placed a minimum depth of 1 1/2" below finished floor.
- B. Random Testing: The testing agency shall take a minimum of 10 random tests of the joint filler material per 20,000 sq. ft. of slab area, to ensure that no backer rod is installed at sawcuts.

3.14 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas. Where finished surface of concrete is intended to be left exposed, use methods pre-approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
1. Immediately after form removal, repair defects on surfaces exposed to view, by cutting out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension in solid concrete but not less than 1 inch in depth. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar.
- D. Repairing Slab-on Grade Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
1. Repair finished surfaces containing defects. Surface defects include spalls, pop-outs, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 2. After concrete has cured at least 14 days, correct high areas by grinding.

3. Correct low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
 4. Apply leveling agent to correct unsatisfactory floor surfaces where slab finish tolerances are beyond specified limits.
- E. Perform structural repairs of concrete subject to Structural Engineer's approval.
- F. Apply leveling agent to correct unsatisfactory floor surfaces where slab finish tolerances are beyond specified limits.
1. Apply material as necessary to provide an acceptable surface for flooring contractor.
 2. Application to be in accordance with Manufacturer's directions.

3.15 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to sample materials, perform tests, and submit test reports during concrete placement. Sampling and testing for quality control may include those specified in this Article. An ACI Field Grade 1 Certified technician shall cast all test cylinders and perform all slump cone tests.
- B. 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 one composite sample (four cylinders) for each day's pour of each concrete mix exceeding 10 cu. yd. One set of test cylinders may represent no more than 50 cubic yards of concrete or one day's pour
 2. Slump: ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each concrete mix on each truck delivery load. Concrete used for slump cone test shall not be taken from first or last 15% of each load. Perform additional tests when concrete consistency appears to change.
 3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
 4. Compressive-Strength Tests: ASTM C 39 as follows:
 - a. Test two field-cured specimens at 7 days and two at 28 days.
 - b. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at age indicated.
- C. Strength of each concrete mix will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
- D. Test results shall be reported in writing to Structural Inspector, 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 mix proportions and materials, compressive breaking strength, and type of break for both 7-and 28-day tests.
- E. 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. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42 or by other methods as directed by Architect.

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SECTION 03 47 00

SITE-CAST TILT-PANEL CONCRETE

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes load-bearing, site-cast concrete, including the following:
 - 1. Monolithic tilt-up concrete panels.
- B. Related Sections include the following:
 - 1. Section 03 30 00 for "Cast-in-Place Concrete" for slab-on-grade closure strips, slab finishes and sealers and general concrete construction.
 - 2. Section 05 50 00 for "Metal Fabrications" for cast-in steel embeds.
 - 3. Section 07 92 00 for "Joint Sealants" for elastomeric joint sealants between tilt-up panels.
 - 4. Section 09 91 16 for "Painting" for field painting of tilt-panels.

1.02 SUBMITTALS

- A. Product Data: For each type of manufactured material and product indicated.
- B. Design Mixes: For each concrete mix. Include alternate mix designs when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments. Provide historical test data in accordance with ACI-301 with a minimum of 20 test breaks.
- C. Shop Drawings: Detail fabrication and installation of tilt-up site-cast concrete units. Indicate panel locations, plans, elevations, dimensions, shapes, cross sections, and details of steel embedments.
 - 1. Include steel reinforcement, detailing fabrication, bending, and placing. Include material, grade, bar schedules, stirrup spacing, bent-bar diagrams, arrangement, and supports of concrete reinforcement. Include additional steel reinforcement to withstand hoisting and erection stresses.
 - 2. Include locations and details of embeds, cross-referenced to structural details.
 - 3. Include locations and details of reveals, panel edges and related architectural features.
 - 4. Indicate welded connections by AWS standard symbols. Detail cast-in inserts, connections, and joints, including accessories.
- D. Material Certificates: Signed by manufacturers certifying that each of the following materials complies with requirements:
 - 1. Cementitious materials, admixtures and aggregates.
 - 2. Steel reinforcement.

1.03 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer with a minimum of 3 years documented experience with tilt-up site-cast concrete similar in material, design, and extent to that indicated for this Project.
- B. Concrete Manufacturer Qualifications: A firm complying with ASTM C 94 requirements for production facilities and equipment.
 - 1. Manufacturer must be certified according to the National Ready Mixed Concrete Association's "Certification of Ready Mixed Concrete Production Facilities."
- C. Testing Agency: An independent testing agency, engaged by Owner will conduct the testing indicated, as documented according to ASTM E 548.

- D. 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 analysis for the design and hoisting of tilt-panels of the size indicated.
- E. Source Limitations: Obtain each type or class of cementitious material from the same manufacturer's plant, each aggregate from the same source, and each admixture from the same manufacturer.
- F. Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1, "Structural Welding Code--Steel."
 - 2. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
- G. Codes and Standards: Comply with applicable provisions of the following codes, specifications and standards, unless more stringent provisions are indicated or specified:
 - 1. 2021 International Building Code.
 - 2. ACI 301, "Specification for Structural Concrete."
 - 3. ACI 302.1R, "Guide for Concrete Floor and Slab Construction".
 - 4. ACI 318, "Building Code Requirements for Reinforced Concrete".
 - 5. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
 - 6. ACI 551R-05, "Tilt-Up Concrete Structures".
 - 7. ACI 551.2R-10, "Design Guide for Tilt-Up Concrete Panels".
 - 8. ASTM C618, "Specifications for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete".
 - 9. Concrete Reinforcing Steel Institute (CRSI) "Manual of Standard Practice".
- H. Pre-Installation Conference: Prior to erection of panels, conduct conference at Project site and submit meeting minutes, describing bracing, methods, means and sequencing of panel erection and crane access.

PART 2 - PRODUCTS

2.01 FORMS AND ACCESSORIES

- A. Side Forms: Metal, mini-lam dressed lumber, or other approved materials that are non-reactive with concrete and that will provide continuous, true, and smooth concrete surfaces.
- B. Chamfer or Reveal Strips: Smooth finish wood, metal, PVC, or rubber strips, with sides beveled. Cut plywood, OSB, MDF and similar wood sheet materials are prohibited for use as reveals strips.
 - 1. Perimeter Panel Edge Chamfer Profile: 3/4 inch by 3/4 inch, with 45 degree bevel.
 - 2. Reveal Strip Profile: 1/2 inch deep, with 22 1/2 degree side-draft bevel, widths as indicated.

2.02 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.
- B. Welded-Steel Reinforcing Bars: ASTM A 706, Grade 60, deformed.
- C. Plain-Steel Wire: ASTM A 82, galvanized.
- D. Plain-Steel, Welded Wire Fabric: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.
- E. Deformed-Steel, Welded Wire Fabric: ASTM A 497, flat sheet.
- F. Bar Supports: Manufacture of plastic or CRSI Class 1 plastic-protected galvanized steel wire or Class 2 stainless-steel wire.

2.03 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type 1 or Type II, alkali content not exceeding 0.6 percent.
- B. Normal-Weight Aggregate: ASTM C 33, uniformly graded from a single source, nominal maximum aggregate size of 3/4 inch.
- C. Water: Potable and complying with ASTM C 94.
- D. Admixtures: Certified by manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material and to be compatible with other admixtures and cementitious materials. Do not use admixtures containing calcium chloride.
 - 1. Concrete containing plasticizing admixtures shall have field-verified maximum slump of 3 inches prior to adding admixtures and 7 inches maximum slump at point of placement. Admixtures shall be approved by Structural Engineer prior to delivery of concrete.
- E. Fly Ash: ASTM C 618, Class C or F, proportioned in accordance with ACI 232-4.1, meeting the following:
 - 1. Conform to the requirements of the current edition of ASTM C 618, as follows:
 - a. ASTM C 618, Table 2 Physical Requirements and Table 2A Supplementary Optional Physical Requirements in the following areas:
 - 1) Effectiveness in Controlling Alkali-Silica Reaction.
 - 2) Effectiveness in Contributing to Sulfate Resistance, Procedure A.

2.04 BONDBREAKERS

- A. Waterborne, Chemically-Reactive Bondbreaker: ASTM C 309, Type 1, self-dissipating polymerized emulsion containing no oils, waxes, paraffins, or silicones, compatible with ground slab curing compounds and floor sealer/densifier applications.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to the following:
 - a. Silcoseal Select; Nox-crete Products Group.
 - b. Sure Lift J6WB; Dayton Superior Corp.
 - c. Starseal EZ Lift; Vexicon Chemicals.

2.05 CURING MATERIALS

- A. Moisture-Retaining Cover: ASTM C 171, polyethylene film sheet.
- B. Waterborne, Membrane-Forming Bondbreaker: ASTM C 309, Type 1, Class B, non-reactive type. Where panels are stack-cast, verify compatibility with exterior panel surface patching mortar.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to the following:
 - a. Silcoseal Advantage; Nox-crete Products Group.
 - b. Conspec Tilt-Eez WB; Dayton Superior Corp.
 - c. Starseal Clean Lift; Vexicon Chemicals.
- C. Curing and Sealing Membrane: Clear, self-dissipating, waterborne, membrane-forming curing and sealing compound ASTM C 309, Type 1, Class B. Acceptable products include:
 - 1. Vocomp 20; W. R. Meadows, Inc.
 - 2. Dress & Seal 20; L&M Construction Chemicals, Inc.
 - 3. Kure-N-Seal 20; BASF Construction Chemicals.

2.06 CONNECTION MATERIALS

- A. Carbon-Steel Embedded Plates: ASTM A 36.

- B. Loose Hardware: Furnishing of loose hardware for lifting tilt-up concrete panels by Contractor.
- C. Carbon-Steel Bolts and Studs: ASTM A 307, Grade A, carbon-steel, hex-head bolts and studs; carbon-steel nuts; and flat, unhardened steel washers.
- D. Welded Headed Studs: AWS D1.1, Type B headed studs, cold-finished carbon-steel bars.
- E. Welded-Steel Reinforcing Bars: ASTM A 706, deformed.
- F. Welding Electrodes: Comply with AWS standards.
- G. Hot-Dip Galvanized Finish: Apply zinc coating to steel connections, exposed to the exterior, by hot-dip process complying with ASTM A 123 or ASTM A 153 as applicable.
 - 1. Zinc Repair Paint: ASTM A 780.
- H. Shop-Primed Finish: Prepare surfaces of steel connections, except those surfaces to be embedded in concrete, according to requirements of SSPC-SP 3, and shop-apply primer according to SSPC-PA 1.
 - 1. Primer: Fast-curing, lead-free and chromate-free, modified-alkyd primer complying with performance requirements in FS TT-P-664.

2.07 LIFTING INSERTS AND ACCESSORIES

- A. Furnish inserts, dowels, bolts, nuts, washers, and other items to be cast in panels for tilting and lifting.
- B. Furnish brace anchors and other accessories to be cast in panels and in casting slab for attaching bracing.

2.08 BEARING PADS

- A. Elastomeric Pads: Vulcanized, 100 percent polychloroprene (neoprene) elastomer, molded to size or cut from a molded sheet, 50 to 60 Shore A durometer, minimum tensile strength 2250 psi per ASTM D 412.
- B. Random, Fiber-Reinforced Elastomeric Pads: Preformed, randomly oriented synthetic fibers set in elastomer with a Shore A hardness of 70 to 90 per ASTM D 2240.

2.09 GROUT MATERIALS

- A. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, with minimum water required for placement and hydration.
- B. Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents; capable of developing minimum compressive strength of 5,000 psi in 28 days conforming to CRD-621.

2.10 RELATED MATERIALS

- A. Flashing Reglets: Open type having continuous groove not less than 1-1/8 inches deep by 3/16 inch wide at opening and sloped upward to 45 degrees. Temporarily fill or cover face openings of reglets to prevent intrusion of concrete or debris.
 - 1. Hot-Dip Galvanized Steel Sheet: ASTM A 653, G90 coating, not less than 0.0217 inch thick.

2.11 REPAIR MATERIALS

- A. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene. Combine 1 part portland cement to 1-1/2 parts fine sand in a 50:50 mixture with admixture to a thick paste consistency.
- B. Patching Mortar: Dry-pack mix consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing No. 16 sieve, using only enough water for handling and placing. Acceptable products include:
 - 1. Thorite 400; BASF Construction Chemicals, LLC.
 - 2. Pavcrete; Lyons Manufacturing, Inc.
 - 3. Burke Super Rub; Meadow Burke.

2.12 CONCRETE MIXES

- A. Prepare design mixes for each type and strength of concrete determined by either laboratory trial mixes or field experience. Proportion normal-weight concrete according to ACI 211.1, ACI 304 and ACI 301.
- B. Normal-Weight Concrete: Proportion normal-weight concrete mix as follows:
 - 1. Compressive Strength (28 Days): 4000 psi, and as otherwise indicated on Drawings.
 - 2. Maximum Water-Cementitious Materials Ratio: 0.48.
 - 3. Maximum Slump: 4 inches.
 - 4. Maximum Slump for Concrete Containing High-Range, Water-Reducing Admixture: 7 inches after admixture is added to concrete with 3- to 4-inch slump.
 - 5. Air Content: Add air-entraining admixture at manufacturer's recommended rate to result in concrete at point of placement having an air content of 2 to 4 percent.

2.13 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94. Furnish batch ticket information.
 - 1. When air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.01 FORMS

- A. Construct and brace edge forms so tilt-up concrete panels are of size, shape, alignment, elevation, and position indicated.
 - 1. Construct forms on slab-on-grade or on temporary casting slab, at Contractor's option.
 - 2. Provide for openings, offsets, recesses, reveals, rustications, reglets, and blockouts.
 - 3. Temporarily fill floor slab joints to provide flush casting surface.
 - 4. Place form liners accurately to provide finished surface texture indicated. Align adjacent form liner seams to maintain uniform pattern, sequence and texture. Coat form liners with form-release agent where form liners will be reused.
- B. Accurately place forms to provide required panel dimensions and tolerances. Kerf wood inserts, such as those forming reglets, rustications, and recesses, for easy removal. Set edge forms for panels to achieve required panel thickness.
- C. Chamfer exposed corners and edges using approved chamfer strips fabricated to produce uniformly straight, smooth lines and tight edge joints.

3.02 BONDBREAKERS

- A. Uniformly and continuously apply a single coat of bondbreaker to casting slab surfaces by power spray or roller according to manufacturer's recommended application rate, before placing steel reinforcement. Recoat areas subjected to moisture before drying. Maintain continuity of coating until concrete placement.

3.03 REINFORCEMENT AND INSERTS

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating and placing reinforcement. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
 - 1. Field weld reinforcement according to AWS D1.4, where indicated.
 - 2. Do not tack-weld crossing reinforcing bars.
 - 3. Set wire ties so ends are directed into concrete, away from exposed concrete surfaces.
- B. Accurately place and securely support embedded items, anchorages, inserts, cramps, retainers, bar chords and sleeves, and other items to be built into panels.

3.04 PANEL CASTING, GENERAL

- A. Comply with ACI 301 for handling and placing concrete.
 - 1. Place concrete for each panel in one continuous pour. Deposit concrete in a very slow manner with the use of a flat diverter or other means to prevent the dislodging of aggregate or reinforcing.
 - 2. Consolidate concrete to produce smooth finished surfaces free of air pockets and honeycomb.
- B. Maintain position of steel reinforcement, inserts, and anchors during concrete placement, consolidation, and finishing.
- C. Form chamfers at all exterior edges of panel perimeters, and openings, , unless otherwise indicated.
- D. Screed panel surfaces to correct thickness and level with a straightedge and strike off. Begin initial floating before excess moisture or bleed water appears on the surface. Use bull floats or darbies to form a uniform and open-textured surface plane free of humps or hollows. Do not disturb forms or panel surfaces before beginning finishing operations.

3.05 CASTING TOLERANCES

- A. Cast tilt-up concrete panels, measured at the panel over-all face width and height, without exceeding the following tolerances:
 - 1. Height and Width of Panels: As follows:
 - a. Up to 30 Feet : plus 1/8 inch, minus 1/4 inch.
 - b. Each Additional 10 Feet in excess of 30 Feet: plus or minus 1/8 inch.
 - 2. Thickness: plus or minus 1/4 inch.
 - 3. Location and Size of Openings Cast into Panel: plus 1/2 inch, minus 1/4 inch.
 - 4. Skew of Panel or Opening: Difference in length of diagonals of 1/4 inch per 72 inches with a maximum difference of 1/2 inch.
 - 5. Location and Placement Tolerances of Embedded Items: As follows:
 - a. Inserts, Bolts, Pipe Sleeves: 3/8 inch.
 - b. Lifting and Bracing Inserts: 1/2 inch.
 - c. Lateral Placement of Weld Plates: 1 inch.
 - 6. Deviation of Steel Reinforcement Cover: 3/8 inch, maintain 2 inch minimum cover.

3.06 PANEL FINISHES

- A. Provide the following finish to the face-up, interior side, of concrete tilt-panel surfaces:

1. Float Finish: Consolidate surface of plastic concrete with power-driven floats or by hand floating. Restraighten and cut down high spots and fill low spots. Repeat float passes and restraighten until surface is left with a uniform, smooth, granular texture.
 2. Trowel Finish: After applying float finish, apply first trowel finish and consolidate plastic concrete by hand trowel or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and is uniform in texture and appearance.
 3. Final Trowel Finish: After applying first trowel finish, apply a second trowel finish to achieve a flat consistent smooth finish.
- B. Provide the following finish to the face-down, exterior side, of concrete tilt-panel surfaces:
1. Smooth, Floor-slab-cast Finish: Cast panel to produce a surface free of pockets, sand streaks, and honeycombs. Produce a surface appearance of uniform finish and appearance. Fill or repair floor slab joints or imperfections to eliminate reproducing floor imperfections into face of panel finish.
 2. Form Liner Finish: Cast panel over form liners placed, secured, and sealed over casting slab to produce a textured surface free of pockets, streaks, and honeycombs. Produce a surface appearance of uniform pattern and texture.

3.07 CONCRETE PROTECTION AND CURING

- A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures according to ACI 301.
1. Apply evaporation retarder in hot, dry, and windy weather to protect concrete from rapid moisture loss before and during finishing operations. Apply according to manufacturer's instructions after screeding and bull floating concrete, but before float finishing.
- B. Begin curing immediately after finishing concrete. Cure by one of the following methods:
1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with absorptive cover, water saturated and kept continuously wet.
 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. Cure for not less than seven days. 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 during curing period.

3.08 ERECTION

- A. Use erection equipment with care to prevent damage to floor slabs and panels. Lift, support, and erect panels only at designated lifting or supporting points indicated on Shop Drawings.
1. Do not lift panels until at least 75% of specified 28-day compressive strength has been verified.
- B. Install tilt-up concrete panels level, plumb, square, and true. Place panels on leveled grout setting pads or shims in correct position. Maintain 3/4 inch joint width between panels, unless otherwise indicated.
1. Use bearing pads and shim strips to position panels to maintain uniform joint widths. Excessive deviation in joint width between panels from specified tolerances will require repositioning of panels.
- C. Temporarily brace and support panels securely in position to withstand code wind loads that the completed structure was designed to withstand. Maintain braces and supports in place, until entire supporting structure has been completed and permanent connections to panels are secured.
- D. Anchor panels in place and to one another.
1. Weld steel connectors and embedments as indicated, complying with AWS D1.1.
 2. Solidly fill gaps between foundation system and bottom of panels with grout.

- E. Erection Tolerances: Install tilt-up concrete panels without exceeding the following tolerances:
 - 1. Exterior Face Width of Joints: plus or minus 1/4 inch.
 - 2. Vertical Panel Joint Taper: plus or minus 1/4 inch.
 - 3. Alignment of Horizontal and Vertical Joints and Reveals: 1/4 inch.
 - 4. Maximum Offset in Exterior Face of Adjacent Panels: 1/4 inch.
 - 5. Vertical Panel Plumbness: Maximum variation from top to bottom of panel face: 1/2 inch.

3.09 CONCRETE PANEL SURFACE FINISHING AND REPAIRS

- A. Defective Concrete: Repair and patch defective areas to produce a uniformly smooth finish to exterior panel surfaces. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patch holes and voids left by block-outs, erecting and bracing inserts on tilt-up panels and slabs-on-grade. Cut or chip edges of voids perpendicular to concrete surface.
 - 1. Clean, dampen with water, and brush-coat holes, voids, and block-outs with bonding agent. Fill and compact with patching mortar of a stiff consistency before bonding agent has dried.
 - 2. Finish surfaces of fills and repairs with same texture and finish as surrounding surfaces.
- C. Exterior-Side Formed Surface Defects: Repair surface defects on surfaces exposed to view that include texture irregularities, cracks, spalls, pin-holes, air bubbles, honeycombs, rock pockets, fins and other projections on the exterior surface, and stains that cannot be removed by cleaning.
 - 1. Large Surface Defects: Honeycombs, rock pockets, and voids more than 1/2 inch in any dimension in solid concrete but not less than 1 inch in depth:
 - a. Cut out defects, making edges of cuts perpendicular to concrete surface.
 - b. Clean, dampen with water, and brush-coat holes and voids with bonding agent.
 - c. Fill and compact with patching mortar before bonding agent has dried.
 - 2. Minor Surface Defects: Pin-holes, air-bubble pockets and honeycomb voids more than 1/8 inch in any dimension but not less than 1/2 inch in depth:
 - a. Rub surfaces until smooth and in uniform plane with adjacent surfaces.
 - b. Clean and dampen surface and then brush coat surface with cement patching mortar mixed with water and work into voids, air-pockets and surface holes. Rub surface with sponge float trowel to remove excess grout flush with surface of panel.
 - c. After initial patch has set, apply second coat of patching mortar, then sand rub to eliminate remaining defects and blemishes and produce a smooth uniform plane surface free of grout film, rubbing marks and surface defects.
 - 3. Chamfer and Reveals: Remove fins, projections and mortar-seepage formed from reveal strip irregularities. Patch and fill edges to match panel surface finish.
- D. Perform structural repairs of concrete, subject to Structural Engineer's approval, using epoxy adhesive and patching mortar.
- E. Install sealants along interior and exterior vertical joints in accordance Section 07 92 00 "Joint Sealants".

3.10 CASTING-BED FLOOR SURFACE REPAIR

- A. Repair interior floor slabs-on-grade damaged from tilt-panel edge-form anchors.
- B. Remove chamfer and reveal strip forms and fasteners from floor slabs. Fill and repair floor slab surfaces damaged by fasteners, to match adjacent floor slab finish.
- C. Remove temporary floor joint fillers and air-blast joint clean of debris for proper application of permanent joint sealants.

3.11 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to sample materials, perform tests, and submit test reports during concrete placement. Sampling and testing for quality control may include those specified in this Article. An ACI Field Grade 1 Certified technician shall cast all test cylinders and perform all slump cone tests.
- B. 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 one composite sample (four cylinders) for each day's pour of each concrete mix exceeding 10 cu. yd. One set of test cylinders may represent no more than 50 cubic yards of concrete or one day's pour
 - 2. Slump: ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each concrete mix on each truck delivery load. Concrete used for slump cone test shall not be taken from first or last 15% of each load. Perform additional tests when concrete consistency appears to change.
 - 3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
 - 4. Compressive-Strength Tests: ASTM C 39 as follows:
 - a. Test two field-cured specimens at 7 days and two at 28 days.
 - b. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at age indicated.
- C. Strength of each concrete mix will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
- D. Test results shall be reported in writing to Structural Inspector, 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 mix proportions and materials, compressive breaking strength, and type of break for both 7-and 28-day tests.
- E. 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. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42 or by other methods as directed by Engineer of Record.

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SECTION 05 12 00

STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes the following:
 - 1. Structural steel beams and columns.
 - 2. Architecturally exposed structural steel.
 - 3. Lintels, shelf angles and miscellaneous structural steel items.
 - 4. Non-shrink grout.
- B. Related Sections include the following:
 - 1. Section 03 30 00 for "Cast-In-Place Concrete" for embedment of steel anchorage devices in concrete.
 - 2. Section 09 91 13 for "Painting" for surface preparation and requirements for finish painting of exposed structural steel.

1.02 DEFINITIONS

- A. Architecturally Exposed Structural Steel: Interior structural steel exposed to view and exterior structural steel exposed to the elements.

1.03 SUBMITTALS

- A. Shop Drawings: Show fabrication of structural-steel components.
 - 1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 - 2. Include anchor bolt and embedment drawings.
 - 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds.
 - 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts.
- B. Test Reports: Submit reports for welded connection tests.

1.04 QUALITY ASSURANCE

- A. Welding:
 - 1. Performed by certified welders in compliance with procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel."
- B. Certifications:
 - 1. Prior to fabrication, furnish certification of Manufacturer that structural steel material furnished meets or exceeds requirements of ASTM standards referenced.
 - 2. Prior to any site welding operation, submit welders certifications and qualifications.

1.05 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 or other supports and spacers. Protect steel members and packaged materials from erosion and deterioration.
 - 1. Store fasteners in a protected place. Clean bolts and nuts that become rusty before use.

2. 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.

1.06 COORDINATION

- A. Furnish anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

PART 2 - PRODUCTS

2.01 STRUCTURAL-STEEL MATERIALS

- A. Structural Steel Shapes: ASTM A 992.
- B. Steel Shapes, Plate and Bars: ASTM A 36 and ASTM A 572.
- C. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.
- D. Steel Pipe: ASTM A 53, Grade B.
- E. Steel tube columns: ASTM A500, Grade E or S.
- F. Welding Electrodes: Comply with AWS requirements, minimum 70KSI tensile.

2.02 BOLTS, CONNECTORS, AND ANCHORS

- A. Anchor Bolts, Nuts, and Washers: ASTM F 3125, ASTM A 325 Type 1 where indicated and ASTM F 436 hardened carbon-steel washers.
- B. Threaded Rods: ASTM A 36 or ASTM A 307, Grade A.
- C. Clevises/Turnbuckles: ASTM A 108, Grade 1035, cold-finished carbon steel.
- D. Eye Bolts and Nuts: ASTM A 108, Grade 1030, cold-finished carbon steel.

2.03 PRIMER

- A. Ferrous Metal Primer: VOC compliant, water-based modified alkyd primer. Approved coatings include:
 1. Sunburst Coatings: 38 Series. Color 38F2 Dark Gray
 2. Sherwin Williams: B66-A310 Universal Primer. Color: Dark Gray.

2.04 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: 5000 psi, ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application.
- B. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404, Size No. 2. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

2.05 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC's "Specification for Structural Steel Buildings".
 - 1. Camber structural-steel members where indicated.
 - 2. Mark and match-mark materials for field assembly.
 - 3. Complete structural-steel assemblies, including welding, before starting shop-priming operations.
- B. Architecturally Exposed Structural Steel: Comply with fabrication requirements, including tolerance limits, of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for structural steel identified as architecturally exposed structural steel.
- C. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
 - 1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.
- D. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.
- E. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

2.06 SHOP PRIMING

- A. Shop prime steel surfaces except galvanized surfaces.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
 - 1. SSPC-SP 2, "Hand Tool Cleaning."
 - 2. SSPC-SP 3, "Power Tool Cleaning."
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a dry film thickness of not less than 3.0 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments, with steel erector present, for compliance with requirements.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Provide temporary shores, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and wind loads. Remove temporary supports when permanent structural steel and connections, are in place, unless otherwise indicated.

3.03 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and "Specification for Structural Steel Buildings".
- B. Base and Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting base and bearing plates. Clean bottom surface of base and bearing plates.
 - 1. Set base and bearing plates for structural members on wedges, shims, or setting nuts as required.

2. Weld plate washers to top of base plate.
 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 base or bearing plate before packing with grout.
 4. Promptly pack grout solidly between bearing surfaces and base or bearing plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- C. Align and adjust various members forming 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. Maintain individual members of structure level and plumb.
- D. Splice members only where indicated and approved on shop drawings.
- E. Remove erection bolts on welded, architecturally exposed structural steel; fill holes with plug welds; and grind smooth at exposed surfaces.
- F. Do not use thermal cutting during erection unless approved by Structural Engineer of Record. Finish thermally cut sections within smoothness limits in AWS D1.1.
- G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.04 FIELD CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
- B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.
1. Comply with AISC's "Code of Standard Practice for Steel Buildings and Bridges" and "Specification for Structural Steel Buildings" for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.
 2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.

3.05 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.
- B. Bolted Connections: Shop-bolted connections will be inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- C. Welded Connections: Field welds will be visually inspected according to AWS D1.1.
1. In addition to visual inspection, field welds may be tested according to AWS D1.1 and the following inspection procedures, at testing agency's option:
 - a. Liquid Penetrant Inspection: ASTM E 165.
 - b. Ultrasonic Inspection: ASTM E 164.
 - c. Radiographic Inspection: ASTM E 94.
- D. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

3.06 REPAIRS AND PROTECTION

- A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists and accessories, bearing plates, and abutting structural steel.
 - 1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
 - 2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.
- C. Metal Seam Sealant: After framing installation and primer repairs, install continuous bead of sealant at metal seams between adjoining metal framing members exposed to view. Tool bead concave to match width of welds at non-welded joints. Paint sealant joints to match adjacent steel in accordance with Section 09 91 13 for "Painting" for surface preparation and requirements for finish painting of exposed structural steel.

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SECTION 05 21 00

STEEL JOISTS

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes the following:
 - 1. Open-web K-series steel roof joists.
 - 2. Joist-girders.
 - 3. Joist accessories.
- B. Related Sections include the following:
 - 1. Section 01 10 00 for "General Requirements" for joists deferred AHJ submittal requirements.
 - 2. Section 03 47 00 for "Site-Cast Tilt-Panel Concrete" for installing bearing plates and ledger angles in tilt-panel concrete.
 - 3. Section 05 50 00 for "Metal Fabrications" for furnishing steel bearing plates.

1.02 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide special joists and connections capable of withstanding design loads within limits and under conditions indicated.
- B. Design joists to support future point loads as follows:
 - 1. Equipment load of 650 pounds at any point along joist in addition to mechanical equipment loads shown on Drawings.
- C. Design joists to withstand design loads with live load deflections no greater than the following:
 - 1. Vertical live-load deflection of 1/240 of the span.
 - 2. Vertical total-load deflection of 1/180 of the span.

1.03 SUBMITTALS

- A. Shop Drawings: Show layout, mark, number, type, location, and spacings of joists. Include joining and anchorage details, bracing, bridging, accessories; splice and connection locations and details; and attachments to other construction.
 - 1. Indicate locations and details of anchorage devices and bearing plates to be embedded in other construction.
 - 2. Engineering analysis certified by the qualified professional engineer responsible for its preparation.
- B. Welding Certificates: Copies of certificates for welding procedures and personnel.
- C. Research/Evaluation Reports: Evidence of steel joists' compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing joists similar to those indicated for this Project and with a record of successful in-service performance.
 - 1. Manufacturer must be certified by SJI to manufacture joists complying with SJI standard specifications and load tables.

2. Assumes responsibility for engineering special joists to comply with performance requirements. This responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
 3. Professional Engineer Qualifications: A professional engineer who is legally authorized 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 joists that are similar to those indicated for this Project in material, design, and extent.
- B. SJI Specifications: Comply with SJI's "Standard Specifications Load Tables and Weight Tables for Steel Joists and Joist Girders", applicable to types of joists indicated.
- C. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel"; and AWS D1.3 "Structural Welding Code--Sheet Steel."

1.05 SEQUENCING

- A. Coordinate the delivery of steel bearing plates and other devices to be built into concrete and masonry construction.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Steel: Comply with SJI's "Specifications" for chord and web members.
- B. Steel Bearing Plates: ASTM A 36.
- C. Carbon-Steel Bolts and Threaded Fasteners: ASTM A 307, Grade A carbon-steel, hex-head bolts and threaded fasteners; carbon-steel nuts; and flat, unhardened steel washers.
1. Finish: Plain, uncoated.
- D. High-Strength Bolts and Nuts: ASTM A 325, Type 1, heavy hex steel structural bolts, heavy hex carbon-steel nuts, and hardened carbon-steel washers.
1. Finish: Plain, uncoated.
- E. Welding Electrodes: Comply with AWS standards.

2.02 PRIMERS

- A. Metal Primer: Fast-curing, lead- and chromate-free, VOC compliant, water-based modified alkyd acrylic primer. Approved coatings include:
1. Sunburst Coatings: 38 Series. Color 38F2 Dark Gray
 2. Sherwin Williams: B66-A310 Universal Primer. Color: Dark Gray.

2.03 OPEN-WEB STEEL JOISTS

- A. Manufacture steel joists according to "Standard Specifications for Open Web Steel Joists" in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord; of joist type indicated.
1. Joist Types: as indicated on Drawings.
- B. Comply with AWS requirements and procedures for shop welding, appearance, quality of welds, and methods used in correcting welding work.

- C. Provide holes in chord members for connecting and securing other construction to joists, where indicated.
- D. Camber joists for design dead-load and as indicated.
- E. Top-Chord Extensions: Extend top chords of joists with SJI's Type S top-chord extensions where indicated, complying with SJI's "Specifications."
- F. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes where joist slope exceeds 1/4 inch per 12 inches.

2.04 JOIST GIRDERS

- A. Manufacture joist girders according to "Standard Specifications for Joist Girders," in SJI's "Specifications," with steel-angle top- and bottom-chord members; with end and top-chord arrangements as indicated.
- B. Provide holes in chord members for connecting and securing other construction to joist girders.
- C. Camber joists for design dead-load and as indicated.
- D. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

2.05 JOIST ACCESSORIES

- A. Bridging: Provide bridging anchors and number of rows of horizontal or diagonal bridging as schematically indicated. Detail and fabricate according to SJI's "Specifications."
- B. Fabricate steel bearing plates with integral anchorages of sizes indicated. Shop prime paint.
- C. Supply extensions, either extended bottom-chord elements or a separate extension unit of enough strength to support piping construction over 4 inches in diameter. Extend ends to within 3 inches of finished wall surface, unless otherwise indicated.
- D. Supply miscellaneous accessories, including splice plates and bolts required by joist manufacturer to complete joist installation.

2.06 CLEANING AND SHOP PAINTING

- A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories to be primed by hand-tool cleaning, SSPC-SP 2 or power-tool cleaning, SSPC-SP 3.
- B. Apply one shop coat of primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 3.0 mils thick.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine supporting substrates, embedded bearing plates, and structural framing, with Installer present, for compliance with requirements for installation tolerances and conditions affecting performance.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Do not install joists until supporting construction is in place and secured.
- B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications," joist manufacturer's written recommendations, and requirements in this Section.
 - 1. Before installation, splice joists delivered to Project site in more than one piece.
 - 2. Space, adjust, and align joists accurately in location before permanently fastening.
 - 3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
- C. Field weld joists to supporting steel bearing plates. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
- D. Bolt joists to supporting steel framework using high-strength structural bolts, unless otherwise indicated. Comply with RCSC's "Allowable Stress Design Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts".
- E. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

3.03 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.
- B. Field welds will be visually inspected according to AWS D1.1.
- C. Bolted connections will be visually inspected.
- D. Correct deficiencies in Work that inspections and test reports have indicated are not in compliance with specified requirements.
- E. Additional testing will be performed to determine compliance of corrected Work with specified requirements.

3.04 REPAIRS AND PROTECTION

- A. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists and accessories, bearing plates and abutting structural steel.
 - 1. Clean and prepare surfaces by hand-tool cleaning, SSPC-SP 2, or power-tool cleaning, SSPC-SP 3.
 - 2. Apply a compatible primer of the same type as the shop primer used on adjacent surfaces.

END OF SECTION

SECTION 05 31 23

STEEL DECKING

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes the following:
 - 1. Galvanized steel roof deck.
- B. Related Sections include the following:
 - 1. Section 07 72 00 for "Roof Accessories" for framing deck openings and expansion joint assemblies, if any.

1.02 SUBMITTALS

- A. Product Data: For each type of deck, accessory, and product indicated.
- B. Shop Drawings: Show layout and types of deck panels, anchorage details, reinforcing channels, pans, deck openings, special jointing, accessories, and attachments to other construction.
- C. Product Certificates: Deck manufacturer certification that products furnished comply with requirements.
- D. Welding Certificates: Copies of certificates for welding procedures and personnel.
- E. Research/Evaluation Reports: Evidence of steel deck's compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.

1.03 QUALITY ASSURANCE

- A. Certifications:
 - 1. Prior to fabrication, furnish certification of Manufacturer that structural steel material furnished meets or exceeds requirements of ASTM standards referenced.
 - 2. Prior to any site welding operation, submit welders certifications and qualifications.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:
 - 1. Nucor Corp.; Vulcraft Div.
 - 2. Verco Manufacturing Co.
 - 3. New Millennium Building Systems.

2.02 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. 29. Minimum allowable diaphragm shear, furnished per ICBO report, shall be 1914 pounds per lineal foot.
 - 1. Galvanized Steel Sheet: ASTM A 653, minimum yield stress of 50,000 psi, phosphatized, G90 zinc coating.
 - 2. Deck Profile: per General Structural Notes.
 - 3. Profile Depth: 1 1/2 inches.
 - 4. Design Uncoated-Steel Thickness: 20 gauge.
 - 5. Span Condition: Triple span or more.
- B. Steel Roof Deck (snow-drift areas): Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 29. Minimum allowable diaphragm shear, furnished per ICBO report, shall be 1914 pounds per lineal foot.
 - 1. Galvanized Steel Sheet: ASTM A 653, minimum yield stress of 50,000 psi, phosphatized, G90 zinc coating.
 - 2. Deck Profile: per General Structural Notes.
 - 3. Profile Depth: 1 1/2 inches.
 - 4. Design Uncoated-Steel Thickness: 18 gauge.
 - 5. Span Condition: Triple span or more.

2.03 ACCESSORIES

- A. General: Provide manufacturer's standard accessory materials 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. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- D. Miscellaneous Sheet Metal Deck Accessories: steel sheet, of same material and finish as deck; of profile indicated or required for application.
- E. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 16 ga., with factory-punched hole of 3/8-inch minimum diameter.
- F. Galvanizing Repair Paint: ASTM A 780 SSPC-Paint 20, with dry film containing a minimum of 94 percent zinc dust by weight.

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 temporary shoring before placing deck panels, if required to meet deflection limitations.
- B. Locate decking bundles to prevent overloading of supporting members.
- C. Place deck panels on supporting frame with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

- D. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to decking.
- E. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 29, manufacturer's written instructions, and requirements in this Section.
- F. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of decking, and support of other work.
- G. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

3.03 DECK INSTALLATION

- A. Fasten deck panels to steel supporting members with powder-actuated shot-pins as follows:
 - 1. Deck Fastener Spacing: Refer to structural drawings for spacing and fastener types.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding 12 inches o.c. and as follows:
 - 1. Side-Laps: Mechanically clinch or button punch.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches with end joints lapped 2 inches minimum.
- D. Roof Sump Pans and Sump Plates: Install over openings provided in roof decking and weld flanges to top of deck. Space welds not more than 12 inches apart with at least 1 weld at each corner.

3.04 FIELD QUALITY CONTROL

- A. Testing: Owner will engage a qualified independent testing agency to perform field quality-control testing. Field welds will be subject to inspection. Testing agency will report test results promptly and in writing to Contractor and Architect.
- B. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.05 REPAIRS

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION

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SECTION 05 50 00

METAL FABRICATIONS

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes the following:
 - 1. Pipe bollards.
 - 2. Steel ladders.
 - 3. Ladder safety cages.
 - 4. Traffic sign posts.
 - 5. Cast-in steel embed plates and shelf angles.
 - 6. Loading-dock door cast-in corner guards.
 - 7. Dock leveler floor edge angles.
 - 8. Steel pipe guardrails.
 - 9. Steel framing and supports for mechanical and electrical equipment.
 - 10. Steel framing and supports for applications where framing and supports are not specified in other Sections.
- B. Related Sections include the following:
 - 1. Section 03 47 00 for "Site-Cast Tilt-Panel Concrete" for coordination of cast-in steel embeds.
 - 2. Section 05 51 10 for "Steel Stairs" for steel stairs and associated stair pipe railings.
 - 3. Section 06 10 50 for "Rough Carpentry" for metal anchors and other rough hardware.
 - 4. Section 09 91 16 for "Painting" for painting of metal fabrications.
 - 5. Section 32 31 31 for "Fences and Gates" for sliding metal gates and rough hardware.

1.02 SUBMITTALS

- A. Shop Drawings: Detail fabrication and erection of each metal fabrication indicated. Include plans and details of metal fabrications and their connections. Show anchorage and accessory items.
 - 1. Provide templates for anchors and bolts specified for installation under other Sections.

1.03 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm experienced in producing metal fabrications similar to those indicated for this Project and with a record of successful in-service performance.
- B. Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1, "Structural Welding Code--Steel."

1.04 PROJECT CONDITIONS

- A. Field Measurements: Where metal fabrications are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating metal fabrications without field measurements.

1.05 COORDINATION

- A. Coordinate installation of anchorages for metal fabrications. 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: For metal fabrications 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.

2.02 FERROUS METALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Steel Tubing: Cold-formed steel tubing complying with ASTM A 500.
- C. Steel Pipe: ASTM A 53, standard weight, unless otherwise is indicated.
- D. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

2.03 PRIMER

- A. Interior Metal Primer: VOC compliant, water-based acrylic primer. Approved coatings include:
 - 1. Tnemec: 10-99W. Color: 1009 Gray.
 - 2. Sherwin Williams: B66-A310 Universal Primer. Color: Gray.
- B. Exterior Metal Primer: VOC compliant, modified alkyd primer. Approved coatings include:
 - 1. Tnemec: FD88 Primer. Color: 559 Gray.
 - 2. Sherwin Williams: B50AZ6 Universal Primer. Color: Gray.

2.04 GROUT

- A. Nonshrink, Nonmetallic Grout: Factory-packaged, non-staining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout recommended by manufacturer for specific applications.

2.05 FASTENERS

- A. General: Provide Type 304 or 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633, where built into exterior walls.
- B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.
- C. Anchor Bolts: ASTM F 1554, Grade 36.
- D. Machine Screws: ASME B18.6.3.
- E. Lag Bolts: ASME B18.2.1.
- F. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to four times the load imposed when installed in unit masonry or in concrete, as determined by testing per ASTM E 488.
 - 1. Material: Carbon-steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5.

2.06 CONCRETE FILL

- A. Concrete Materials and Properties: Comply with requirements Section 03 30 00 - "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3000 psi, unless otherwise indicated.

2.07 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations.
- B. Shear and punch metals cleanly and accurately. Remove burrs.
- C. Ease exposed edges to a radius of approximately 1/16 inch, unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation.
- D. Weld corners and seams continuously to comply with the following:
 - 1. Use methods that minimize distortion and develop corrosion resistance of base metals.
 - 2. At exposed connections, finish exposed welds and surfaces smooth so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- E. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
- F. Cut, reinforce, drill, and tap metal fabrications to receive finish hardware, screws, and similar items.
- G. Fabricate joints that will be exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate.
- H. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.
- I. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts. Locate joints where least conspicuous.

2.08 PIPE BOLLARDS

- A. Fabricate pipe bollards from Schedule 40 steel pipe.
 - 1. Cap interior bollards with 1/4-inch- minimum steel plate.
 - 2. Fill exterior bollards with concrete and cap with concrete crowned to provide drainage.
- B. Fabricate base plates for floor-mounted bollard anchorage from 1/2-inch thick steel plate welded to bottom of pipe.

2.09 SIGN POSTS

- A. Fabricate sign posts from 2" x 4" tube steel sections.
 - 1. Cap posts with 1/4-inch steel plate.
- B. Fabricate base plates for bollard anchorage from 1/4-inch thick steel plate welded to bottom of pipe.

2.10 FIXED STEEL LADDERS

- A. General: Fabricate ladders from steel components for locations shown, with dimensions as indicated.
- B. Siderails: Continuous, 1/2-by-2-1/2-inch steel flat bars, with eased edges, spaced 24 inches apart.

- C. Bar Rungs: 3/4-inch diameter steel bars, spaced 12 inches o.c. Fit rungs in centerline of side rails; plug-weld and grind smooth on outer rail faces.
- D. Support each ladder at top and bottom and not more than 60 inches o.c. with welded or bolted steel brackets. Size rungs and brackets to support design live loads of 200 pounds and as specified in ANSI A14.3.
- E. Intermediate Platform: Where ladder height exceeds 20-feet, provide 4'-0" x 6'-0" off-set platform landing fabricated from 1/4" steel diamond plate and 3" x 3" x 1/4" steel angle framing and wall braces. Provide 1 1/4" Schedule 40 pipe guard railings around perimeter of platform.

2.11 FIXED STEEL LADDER SAFETY CAGES

- A. General: Fabricate ladder safety cages to comply with ANSI A14.3. Assemble by welding.
- B. Primary Hoops: 5/16-by-4-inch steel flat bar hoops. Provide at tops and bottoms of cages and spaced not more than 20 feet o.c.
- C. Secondary Intermediate Hoops: 5/16-by-2-inch steel flat bar hoops, spaced not more than 48 inches o.c. between primary hoops.
- D. Vertical Bars: 5/16-by-2-inch steel flat bars secured to each hoop, spaced approximately 9 inches o.c.

2.12 CAST-IN EMBED PLATES AND ANGLES

- A. General: Provide steel framing and supports that are not a part of structural-steel framework as necessary to complete the Work. Coordinate location and placement of embeds with approved tilt-panel submittals.
- B. Fabricate loose structural-steel embed plates from steel angles and shapes of size indicated for connection and support of site-cast tilt panels. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction retained by framing and supports.
 - 1. Where units are indicated to be cast into concrete, provide integrally welded steel stud anchors of size and spacing as indicated.
- C. Fabricate dock leveler floor edge angles from galvanized steel angles of sizes indicated and for welded stud attachment. Coordinate frame sizes with dock leveler manufacturer.

2.13 LOADING-DOCK DOOR CAST-IN EMBEDS

- A. Corner Guards: Fabricate channel-profile embeds from 4'-0" long x 1/4" steel plate, bent to conform to tilt-panel thickness, with welded studs at 16" o.c. vertically to be cast-in tilt-panel concrete. Locate bottom of plate guard to align with interior floor elevation.
- B. Floor Edge Channels: Fabricate members from C12 x 20.7 steel channels with 1/2" dia. x 4" long, welded head-studs at 16" o.c. horizontally to be cast in tilt-panel. Provide one-piece edge channels full length of dock door opening width.

2.14 STEEL PIPE GUARDRAILS

- A. Guardrails: Fabricate steel pipe guardrails to design, dimensions, and details indicated. Provide railings and handrails members formed of standard weight Schedule 40, 1 1/2-inch inside diameter pipe, but not less than that required to support design loading, and as follows:
 - 1. Railings may be bent at corners, rail returns and wall returns, in lieu of using prefabricated fittings.

- B. Brackets, Flanges, Fittings and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings and anchors for interconnections of pipe and attachment of railings to other work. Furnish inserts and anchorage devices for connecting railings to concrete or masonry.
 - 1. For railing posts set in concrete provide sleeves of galvanized steel pipe not less than 6" long and with an inside diameter not less than 1/2" greater than the outside diameter of pipe. Provide steel plate closure welded to bottom of sleeve and of width and length not less than 1" greater than outside diameter of sleeve.

2.15 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal fabrications after assembly.

2.16 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with applicable standard listed below:
 - 1. ASTM A 153, for galvanizing steel and iron hardware.
- B. 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 metal fabrications:
 - 1. Exteriors (SSPC Zone 1B): SSPC-SP 6, "Commercial Blast Cleaning."
- C. Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes. Comply with SSPC-PA 1, "Paint Application Specification No. 1," for shop painting. Paint corners, crevices, bolts, welds, and edges.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal fabrications to in-place construction. Include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws, and other connectors.
- B. Cutting, Fitting, and Placement: Perform field 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.
- C. 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.
- D. 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. At exposed connections, finish exposed welds and surfaces smooth so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

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, if any.

- B. Support steel beams on steel pipe columns. Secure beams with bolts through top plates of pipe columns.
- C. Install pipe columns on concrete footings with grouted base plates. Position and grout column base plates as specified above for setting and grouting bearing and leveling plates.
 - 1. Do not grout base plates of columns supporting steel girders until girders are installed and leveled

3.03 INSTALLING PIPE BOLLARDS.

- A. Anchor bollards in wet concrete footings to depth indicated. After bollards have been inserted, fill interior of bollard and sleeve solidly with concrete grout and slope grout up approximately 1/2 inch up to drain.

3.04 ANCHORING RAIL POSTS

- A. Anchor posts to metal surfaces with square flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:
 - 1. For steel pipe railings, weld flanges to post and bolt flange to metal supporting surfaces.

3.05 ADJUSTING AND CLEANING

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.
- B. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 4.0-mil dry film thickness.

END OF SECTION

SECTION 05 51 10

STEEL STAIRS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes steel stair and miscellaneous metal fabrications, anchorages, supports, rough hardware, complete and includes the following:
 - 1. Exterior exit-egress stairs.
- B. Related Sections include the following:
 - 1. Section 06 10 50 for "Rough Carpentry" for metal anchors and other rough hardware.
 - 2. Section 09 91 13 for "Painting" for painting of exterior steel fabrications.

1.02 SYSTEM PERFORMANCE

- A. Design Requirements: Provide stair assemblies designed and fabricated to support dead load plus the following live loads with a maximum deflection of 1/240:
 - 1. Live Load: 100 psf.
 - 2. Concentrated Load: 300 pounds.

1.03 SUBMITTALS

- A. Shop Drawings: Detail fabrication and erection of each metal fabrication indicated. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Coordinate and provide templates for anchors and bolts for installation of Work under other Sections.

1.04 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm experienced in designing and producing metal fabrications similar to those indicated for this Project.
- B. Regulatory Requirements: Comply with local code and regulatory requirements for stair design and the following:
 - 1. 2010 ADA "Standards for Accessible Design" and ADA Guidelines, as applicable.
 - 2. 2018 International Building Code, Chapter 11.
- C. Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1, "Structural Welding Code--Steel."

1.05 PROJECT CONDITIONS

- A. Field Measurements: Where metal fabrications are required to fit with other construction, verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings.
- B. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating metal fabrications without field measurements.

PART 2 - PRODUCTS

2.01 FERROUS METALS

- A. Metal Surfaces, General: For metal fabrications 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.
- B. Steel Plates, Shapes, and Bars: ASTM A 36.
- C. Steel Tubing: Cold-formed steel tubing complying with ASTM A 500, Grade B.
- D. Steel Pipe: ASTM A 53, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.
- E. Steel Sheet: ASTM A 570, Grade 30.

2.02 PAINT

- A. Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, modified-alkyd primer with good resistance to normal atmospheric exposure, complying with performance requirements of FS TT-P-664.
 - 1. VOC Content: Paints and coatings used at the building interior shall comply with VOC limits.

2.03 FASTENERS

- A. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.
- B. Anchor Bolts: ASTM F 1554, Grade 36.
- C. Machine Screws: ASME B18.6.3.

2.04 METAL-GRATE TREADS

- A. Stair Treads and Landings: 3/16" x 2" deep welded steel bar grating tread assembly with carrier bearing bars spaced a maximum of 1 1/4" o.c. parallel with nosing edge to support a 300 lb concentrated load at mid-point of tread span. Cross-bar spacing 4" o.c.
 - 1. Tread Profile: 12" wide.
 - 2. Tread Nosing: 14 ga. steel, rolled checker plate.
 - 3. Finish: G-90 galvanized.
 - 4. Manufacturer: Grating Pacific 19-W-4 or McNichols: GW-200.

2.05 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. 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. Shear and punch metals cleanly and accurately. Remove burrs. Ease exposed edges to a radius of approximately 1/32 inch, unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

2.06 STEEL FRAMED STAIRS

- A. General: Construct stairs to conform to sizes and arrangements indicated; join pieces together by welding unless otherwise indicated. Provide complete stair assemblies including metal framing,

hangers, columns, railings, newels, struts, clips, brackets, bearing plates and other components necessary for the support of stairs and platforms and as required to anchor and contain the stairs on the supporting structure.

- B. Stair Framing: Fabricate stringers of structural steel channels as indicated. Provide closures plates for exposed ends of stringers. Construct platforms of structural steel channel headers and miscellaneous framing members as indicated. Bolt or weld headers to stringers and framing members to stringers and headers.
- C. Metal Grate Risers and Landing Platforms: Shape metal risers and treads to conform to configurations shown.
 - 1. Form metal landing platforms from galvanized bar-grating of same configuration as treads.
 - 2. Directly attach grating to stringer angle brackets by means of j-bolts provide by grating manufacturer.
- D. Stair Railings: Fabricate steel pipe railings to design, dimensions, and details indicated. Provide railings and handrails members formed of standard weight Schedule 40, 1 1/2-inch inside diameter pipe, but not less than that required to support design loading, and as follows:
 - 1. Railings may be bent at corners, rail returns and wall returns, instead of using prefabricated fittings.
 - 2. Connect railing posts to stair framing by direct welding.
- E. Brackets, Flanges, Fittings and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings and anchors for interconnections of pipe and attachment of railings and handrails to other work. Furnish inserts and anchorage devices for connecting railings and handrails to concrete or masonry.
 - 1. For railing posts set in concrete provide sleeves of galvanized steel pipe not less than 6" long and with an inside diameter not less than 1/2" greater than the outside diameter of pipe. Provide steel plate closure welded to bottom of sleeve and of width and length not less than 1" greater than outside diameter of sleeve.

2.07 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports indicated and as necessary to complete the Work.
- B. Fabricate units from structural-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 retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.

2.08 STEEL AND IRON FINISHES

- A. Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes. Comply with SSPC-PA 1, "Paint Application Specification No. 1," for shop painting. Stripe paint corners, crevices, bolts, welds, and sharp edges.
- B. Finish metal fabrications after assembly.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal fabrications to in-place construction. Include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws, and other connectors.

- B. 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.
- C. 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.
- D. Field Welding: Perform by the shielded arc method. 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.

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. Support steel beams on steel pipe columns. Secure beams with bolts through top plates of pipe columns.
- C. Install steel stringers on concrete footings with grouted base plates. Position and grout base plates as specified above for setting and grouting bearing and leveling plates.

3.03 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

END OF SECTION

SECTION 06 10 50
ROUGH CARPENTRY

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes the following:
 - 1. Mounting boards for panel boards and telephone equipment.

1.02 DEFINITIONS

- A. Rough Carpentry: Carpentry work not specified in other Sections and not exposed, unless otherwise indicated.
- B. Exposed Framing: Dimension lumber not concealed by other construction.

1.03 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. Metal framing anchors.
- B. Submit research or evaluation reports of the model code organization acceptable to authorities having jurisdiction that evidence the following products' compliance with building code in effect for Project.
 - 1. Metal framing anchors.
 - 2. Power-driven fasteners.
 - 3. Powder-actuated fasteners.
- C. Shop Drawings: For engineered wood products, submit to Architect shop drawings showing layout, mark, number, type, location, and spacing of member. Include joining and anchorage details, bridging, bracing, accessories, and connection details and attachment to other units of work.

1.04 QUALITY ASSURANCE

- A. Identify each piece of lumber or plywood used for structural framing with grade and trademark of lumber grading organization.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Keep materials under cover and dry. Protect from weather and contact with damp or wet surfaces. Stack lumber, plywood, and other panels. Provide for air circulation within and around stacks and under temporary coverings.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include any manufacturer that meets or exceeds the referenced standards listed in ICC-ES.

2.02 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20, "American Softwood Lumber Standard," and applicable rules of lumber grading agencies certified by the American Lumber Standards Committee Board of Review.
- B. 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.
 - 1. Provide dressed lumber, S4S, unless otherwise indicated.
 - 2. Provide dry lumber with 19 percent maximum moisture content at time of dressing for 4-inch nominal thickness or less, unless otherwise indicated.

2.03 STRUCTURAL-USE PANELS FOR BACKING

- A. Plywood Backing Panels: For mounting electrical or telephone equipment, provide fire-retardant-treated plywood panels with grade, C-D Plugged Exposure 1, in not less than 23/32 inch thickness.

2.04 FASTENERS

- A. Wood Screws: ASME B18.6.1.
- B. Lag Bolts: ASME B18.2.1.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

- A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough 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. Use screw-type fasteners, 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; predrill as required.
- C. Install and secure framing members of size and at spacings indicated. Do not splice structural members between supports.

3.02 EQUIPMENT BACKER BOARDS

- A. General: Confirm equipment sizes, location and wall arrangement. Anchor plywood sheets to supporting construction, fastened 24 inches o.c., unless otherwise indicated.

END OF SECTION

SECTION 07 11 10

BITUMINOUS DAMPPROOFING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Cold-applied, emulsified-asphalt dampproofing for vertical applications at the following conditions:
 - 1. Back-side of above-grade site and ramp retaining walls in contact with sub-grade fill.
 - 2. Back-side of below-grade site retaining walls in contact with landscape-fill.
 - 3. Exterior below-grade steel columns and base plates.

1.02 SUBMITTALS

- A. Product Data: For each type of product indicated. Include recommendations for method of application, primer, number of coats, coverage or thickness, and protection course.

1.03 QUALITY ASSURANCE

- A. Source Limitations: Obtain primary dampproofing coatings and primers through one source from a single manufacturer. Provide secondary materials compatible with primary coating materials.

PART 2 - PRODUCTS

2.01 COLD-APPLIED EMULSIFIED-ASPHALT DAMPPROOFING

- A. Manufacturers: ASTM D 1227, Type II, Class 1, semi-fibrated asphaltic emulsion for brush or spray-coat application with a VOC content of 0.25 lb/gal or less. Subject to compliance with requirements, provide products equal to one of the following:
 - 1. Henry HE789; Henry Company.
 - 2. Hydrocide 700B; BASF Corp
 - 3. 220AF; Karnak Corp.
 - 4. Waterban 60SM; Lambert Corp.

2.02 MISCELLANEOUS MATERIALS

- A. Emulsified-Asphalt Primer: ASTM D 1227, Type III, Class 1, diluted as recommended by manufacturer.
- B. Asphalt-Coated Glass Fabric: ASTM D 1668, Type I.
- C. Patching Compound: Fibered mastic of type recommended by dampproofing manufacturer.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates for compliance with requirements for surface smoothness and other conditions affecting performance of work.
 - 1. Test for surface moisture according to ASTM D 4263.
 - 2. Begin dampproofing application only after substrate construction and penetrating work have been completed and unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Protection of Other Work: Mask or protect adjoining exposed surfaces from being stained, spotted, or coated with dampproofing. Prevent dampproofing materials from clogging weep holes and drains.
- B. Clean substrates of projections and substances detrimental to work; fill voids, seal joints, and apply bond breakers if any, as recommended by dampproofing materials manufacturer.
 - 1. Apply patching compound for filling and patching tie holes, honeycombs, reveals, and other imperfections, in accordance with Section 03 30 00 "Cast-in-Place Concrete".

3.03 DAMPPROOFING APPLICATION

- A. Comply with manufacturer's written recommendations unless more stringent requirements are required by Project conditions to ensure satisfactory performance of dampproofing.
 - 1. Apply additional coats if recommended by manufacturer to achieve coverages indicated.
 - 2. Allow each coat of dampproofing to cure six hours before applying subsequent coats.
 - 3. Allow 24 hours drying time prior to backfilling.
- B. Apply dampproofing to footings and foundation walls exposed to soil where opposite side of wall is exposed to interior of building or exterior above-grade conditions.
 - 1. Apply from finished-grade line to top of footing, extend over top of footing, and down a minimum of 6 inches over outside face of footing.
 - 2. Extend 12 inches onto intersecting walls and footings, but do not extend onto surfaces exposed to view when Project is completed.
 - 3. Install flashings and corner protection stripping at internal and external corners, changes in plane, construction joints and cracks by embedding an 8-inch-wide strip of asphalt-coated glass fabric in a heavy coat of dampproofing.
- C. Backside of Concrete Retaining Walls: Apply one brush or spray coat at not less than 1.5 gal./100 sq. ft.
- D. Backside of Masonry Retaining Walls: Apply primer and one brush or spray coat at not less than 2 gal./100 sq. ft.

3.04 INSTALLATION OF PROTECTION COURSE

- A. Install protection course over completed-and-cured dampproofing.
 - 1. Support protection course with spot application of adhesive of type recommended by protection board manufacturer over cured coating.

3.05 CLEANING

- A. Remove dampproofing materials from surfaces not intended to receive dampproofing.

END OF SECTION

SECTION 07 21 16
BUILDING INSULATION

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes the following:
 - 1. Concealed wall insulation.
 - 2. Exposed wall insulation.
- B. Related Sections include the following:
 - 1. Section 07 54 23 for "Single-Ply Membrane Roofing" for above-deck insulation specified as part of roofing membrane assembly, if any.

1.02 REFERENCES

- A. ASTM International (ASTM)
 - 1. ASTM C 665, Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction.

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated. Include r-value certifications and fire-resistive ratings.

1.04 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of building insulation through one source.
- B. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
 - 1. Surface-Burning Characteristics: ASTM E 84.
 - 2. Fire-Resistance Ratings: ASTM E 119.
 - 3. Sound-Transmission Class: ASTM C 423.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

PART 2 - PRODUCTS

2.01 INSULATING MATERIALS

- A. General: Provide insulating materials that comply with requirements and with referenced standards.

- B. Unfaced Mineral-Fiber Blanket Insulation: ASTM C 665, Type I, Class A, glass fiber batts; with maximum flame-spread and smoke-developed indices of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics. Provide single thickness batts, for stud-wall locations as indicated, to provide thermal-resistance values as follows:
 - 1. Overall R-Value (2" x 8" wall framing): R-19.
- C. Foil-Faced Rigid Wallboard Insulation: ASTM C 1289, Type II, non-organic, closed cell polyisocyanurate rigid insulation board with 15 mil glass-fiber mat facers; one side faced with reflective foil membrane and one side with white foil-scrim-polyethylene membrane.
 - 1. R-Value: 6.3 per inch.
 - 2. Minimum Compressive Strength: 20 psi.
 - 3. Board Thickness: 2-inch.
 - 4. Maximum Board Size: 48 inch by 96 inch.
 - 5. Facing Color: White.
 - 6. Acceptable Product: XCI 286; Hunter Panels.

2.02 INSULATION FASTENERS

- A. Adhesively Attached, Spindle-Type Anchors: Galvanized steel plate, welded to projecting spindle; capable of holding insulation of thickness indicated securely in position indicated with self-locking washer in place; and complying with the following requirements:
 - 1. Spindle Plate: Formed from 0.030-inch- thick, perforated, galvanized steel sheet, 2 inches square.
 - 2. Spindle: Noncorrosive, low carbon steel, fully annealed, 0.105 inch in diameter, length to suit depth of insulation indicated.
 - 3. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to concrete substrates indicated without damaging insulation, fasteners, and substrates.
- B. Mechanical Anchors: Steel pin, powder-driven; capable of holding insulation of thickness indicated securely in place with integral plastic face-washer.
 - 1. IFC-312v2: Ramset I-F Insulation Fasteners
 - 2. X-IE-G6: Hilti Insulation Board Fasteners

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for Sections in which substrates and related work are specified and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION, GENERAL

- A. Do not install insulation until protected from weather that will not damage or wet the insulation.
- B. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- C. Fully insulate small and non-standard size spaces by carefully cutting and fitting insulation material to maintain continuity of insulation.

3.03 CAVITY WALL INSTALLATION

- A. Install mineral-fiber blankets in cavities formed by framing members according to the following requirements:
 - 1. Use blanket widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill cavity, provide lengths that will produce a snug fit between ends.
 - 2. Place blankets in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 - 3. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping stapling flanges to flanges of metal studs.

3.04 RIGID BOARD WALL INSTALLATION

- A. Install rigid board insulation on concrete substrates by mechanically attached, insulation anchors as follows:
 - 1. Begin insulation board installation 12 feet above floor line and extend to underside of roof deck at all perimeter building walls.
 - 2. Fasten insulation anchors to concrete substrates with powder-driven anchors according to anchor manufacturer's written instructions. Space anchors according to insulation manufacturer's written instructions but not less than eight anchors per 4' x 8' sheet.

3.05 PROTECTION

- A. Protect installed insulation and facing membranes from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION

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SECTION 07 26 26

UNDER-SLAB VAPOR BARRIERS

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes under-slab-on-grade, sheet-type, vapor barrier membrane.
- B. Related Work in other Sections includes the following:
 - 1. Section 03 30 00 – “Cast-in-Place Concrete” for coordination with slab-on-grade concrete installation.

1.02 PERFORMANCE REQUIREMENTS

- A. American Society for Testing and Materials (ASTM)
 - 1. ASTM E 1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.
 - 2. ASTM E 154 - Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs.
 - 3. ASTM E 96 - Standard Test Methods for Water Vapor Transmission of Materials.
 - 4. ASTM E 1643 - Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
 - 5. ASTM F 1249 Standard Test Method for Water Vapor Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor.
- B. American Concrete Institute (ACI)
 - 1. ACI 302.2R-06 - “Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials”.

1.03 SUBMITTALS

- A. Product Data: Submit manufacturer’s product data, manufacturer’s printed instructions for installation, preparing, and treating penetrations, and other limitations of installation conditions.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Handle materials in accordance with manufacturer’s recommendations. Remove material from Project that have been punctured or otherwise damaged.

1.05 WARRANTY

- A. Installation Warranty: Provide Installer’s 2 year warranty from date of Substantial Completion, to include all components of the vapor-barrier membrane installation, against failures including loss of membrane seal and moisture penetration through vapor retarder membrane, beyond specified limits.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Plastic Sheet Vapor Barrier: Multi-ply laminated, low-density polyethylene plastic, reinforced membrane, formed into uniform, flexible sheets. Provide related accessories including seam tape, mastic and sealant recommended by manufacturer. Subject to compliance with requirements, provide products from one of the following:
 - 1. Perminator; W.R. Meadows.
 - 2. Vaporguard; Reef Industries, Inc.
 - 3. Stego Wrap Vapor Barrier; Stego Industries.

2.02 MATERIALS

- A. Plastic Vapor Barrier: Vapor barrier membrane must meet or exceed requirements of ASTM E 1745, Class A, and the following properties:
 - 1. Maximum Permeance: 0.01 perms or less.
 - 2. Membrane Thickness: Not less than 15 mils.

2.03 ACCESSORIES

- A. Seam Tape: Polyethylene tape with pressure sensitive adhesive. Minimum tape width of 4 inches.
- B. Penetration Mastic: Manufacturer's recommended, water-based, elastomeric emulsion, suitable for sealing of vapor barrier membrane penetrations.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Coordinate placement and support of in-slab steel reinforcement to avoid puncturing vapor barrier membrane.

3.02 APPLICATION

- A. General: Installation shall be in accordance with manufacturer's instructions and ASTM E 1643.
 - 1. Minimize lineal quantity of seams by placing vapor barrier with the longest dimension parallel with the longest dimension of perimeter building walls.
 - 2. Lap vapor barrier over perimeter wall footings and seal to face of walls.
 - 3. Lap vapor barrier over column footings and seal to column flanges.
 - 4. Overlap seam joints 6" and seal with manufacturer's seam tape.
 - 5. Seal all conduit and pipe penetrations with manufacturer's tape and/or mastic.
 - 6. Repair damaged areas by cutting patches of vapor barrier, overlapping damaged area 12" and taping and sealing all four sides in the same manner as lap seams.
 - 7. Do not cover membrane with sand cushion or aggregate sub-base material. Concrete shall be placed directly in contact with membrane.

END OF SECTION

SECTION 07 42 13

COMPOSITE-METAL WALL PANELS

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes the following:
 - 1. Composite aluminum sheet wall panels and matching sheet fascia-trim.
- B. Related Sections include the following:
 - 1. Section 07 62 00 "Sheet Metal Flashing and Trim" for fascia, copings, flashings and other sheet metal work not part of metal cladding panel assemblies.
 - 2. Section 07 92 00 "Joint Sealants" for field-applied sealants not otherwise specified in this Section.

1.02 COMPONENTS OF THE WORK

- A. General: Contractor shall design, engineer, fabricate, deliver and install a system of metal panel cladding components necessary to provide a complete and weathertight enclosure of the building and fenestration elements indicated on the Contract Documents, including all additional measures necessary for the proper performance of the metal cladding system, notwithstanding any omissions or inadequacies shown or not shown on the Contract Documents.
- B. Aluminum Panel System: PVDF coil-coated, composite aluminum sheet clad panels of 1/4-inch minimum thickness, mechanically attached to a subgirt support framing system. Elements of the Work include:
 - 1. Exterior wall cladding.

1.03 DEFINITIONS

- A. Metal Panel Assembly: Pre-finished metal wall or soffit panels, attachment system components, miscellaneous metal framing, and accessories necessary for a complete weathertight system.
- B. Metal Fascia Trim: Light gauge aluminum sheet, fabricated to profiles to complete metal panel assembly enclosures, attachment components, miscellaneous metal framing, and accessories necessary for a complete weathertight system.

1.04 PERFORMANCE REQUIREMENTS

- A. General: Provide metal panel assemblies that comply with performance requirements specified as determined by testing manufacturers' standard assemblies similar to those indicated for this Project, by a qualified testing and inspecting agency.
- B. Structural Performance: Provide metal panel assemblies capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated, based on testing according to ASTM E 330:
 - 1. Wind Loads: Determine loads based on the following minimum design wind-load design pressures indicated in the General Structural Notes, but not less than:
 - a. Uniform pressure of 10 lbf/sq. ft., acting inward or outward.
 - 2. Deflection Limits: Engineer metal panel assemblies to withstand test pressures with deflection no greater than 1/240 of the span and no evidence of material failure, structural distress, or permanent deformation exceeding 0.2 percent of the clear span.
 - a. Test Pressures: 150 percent of inward and outward wind-load design pressures.

1.05 SUBMITTALS

- A. Product Data: Include joint details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal wall panel and accessory.
- B. Shop Drawings: Show fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
 - 1. Accessories: Include details of the following items:
 - a. Flashings, copings and trim.
 - b. Terminations to adjacent construction.
 - c. Support sub-framing.
- C. Samples: For each type of exposed finish required, prepared on Samples of size indicated below.
 - 1. Metal Panels: 12 inches square. Include fasteners, closures, and other metal panel accessories. Include four-way joint for metal panel system.
 - 2. Trim and Closures: 12 inches long. Include fasteners and other exposed accessories.
- D. Compatibility and Adhesion Test Reports: For wet-sealed panel systems, indicating the materials forming joint substrates and joint sealant backings have been tested for compatibility and adhesion with joint sealants.
- E. Research/Evaluation Reports: For metal panel system.
- F. Warranties: Special warranties specified in this Section.

1.06 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Fabricator of metal-faced wall panels.
 - 1. Engineering Responsibility: Preparation of data for metal panels, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project and meeting the performance requirements specified.
- B. Installer Qualifications: Certified by metal panel manufacturer to fabricate and install manufacturer's panel system.
 - 1. Installer's responsibilities include fabricating and installing metal panel sub-assemblies and providing professional engineering services needed to assume engineering responsibility.
- C. Product Options: Drawings indicate size, profiles, and dimensional requirements of metal wall panels and are based on the specific system indicated.
 - 1. Do not modify intended aesthetic effects, except as subsequently approved on submittals. If modifications are proposed, submit comprehensive explanatory data with initial submittal.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, sheets, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal wall panels for protection during transportation and handling.
- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping. Protect strippable protective covering on metal panels from exposure to sunlight and high humidity, except to extent necessary for period of metal panel installation.

1.08 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal wall panels to be performed according to manufacturers' written instructions and warranty requirements.
- B. Field Measurements: Verify locations of structural members and wall opening dimensions by field measurements before metal wall panel fabrication and indicate measurements on Shop Drawings.

1.09 COORDINATION

- A. Coordinate metal panel assemblies with rain drainage work, flashing, trim, and construction of support framing, soffits, and other adjoining work to provide a leak-proof, secure, and non-corrosive installation.

1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel assemblies that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures, including rupturing, cracking, or puncturing.
 - b. Deterioration of metals, finishes, gaskets and other materials beyond normal weathering.
 - 2. Warranty Period: Five years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5E Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: Ten years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PANEL MATERIALS

- A. Aluminum Sheet: Coil-coated sheet, ASTM B 209, alclad alloy 3003, 3004, or 3105 for painted finishes and alloy 5005 for anodic finishes with temper as required to suit forming operations and structural performance required.
 - 1. Surface: Smooth, flat finish.
- B. Aluminum Extrusions: ASTM B 221, alloy and temper recommended by manufacturer for type of use and finish indicated.

2.02 METAL-FACED COMPOSITE PANELS

- A. General: Provide factory-formed and pre-assembled metal-faced composite fascia panels fabricated from two metal facings bonded, to thermoplastic core; with reveals formed into routed bent-return profile for concealed fastener, dry-joint installation method. Include attachment system components and accessories required for weathertight system. The design of aluminum wall panel systems are based on Alucobond Plus Panel System as manufactured by 3A Composites. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:
 - 1. Available Products:
 - a. Alpolc PE; Mitsubishi Composites.
 - b. Reynobond; Arconic Architectural Products.
 - c. PAC-3000 RS; Pac-Clad Petersen

- B. Aluminum-Faced Composite Wall Panels: Formed with 0.020-inch- thick, coil-anodized or coil-coated painted aluminum sheet facings.
 - 1. Panel Composite Thickness: 0.16 inch (4mm).
 - 2. Core: Composite mineral.
 - 3. Exterior Finish: Fluoropolymer PVDF.
 - a. Color: CZZ Anthra Zinc
- C. Attachment System Components: Formed from extruded aluminum.
 - 1. Provide internal drainage system and allow individual panels to "free float" and be installed and removed without disturbing adjacent panels.
 - 2. Include manufacturer's standard subgirts, perimeter extrusions, tracks, and drainage channels, panel stiffeners, panel clips and anchor channels.
 - 3. Alignment Pins: Stainless steel.
 - 4. Flashing and Trim: Same material, finish, and color as adjacent composite panels, minimum 0.030 inch thick, unless otherwise indicated.

2.03 MISCELLANEOUS METAL SUB-FRAMING COMPONENTS

- A. Steel Sheet Components, General: Complying with ASTM C 645 requirements for metal and with ASTM A 653, G60, hot-dip galvanized or manufacturer's standard corrosion-resistant coating.
- B. Subgirts: C- or Z-shaped sections fabricated from 0.0598-inch steel thickness, non-corrosive, cold-formed, steel sheet.
- C. Zee Clips or Sill Angles: 0.079-inch steel thickness, cold-formed, galvanized steel sheet.
- D. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
 - 1. Minimum Base Metal Thickness: 20 gauge.
 - 2. Depth: 7/8 inch or 1-1/2 inches, as indicated.
- E. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, minimum bare metal thickness of 0.0179 inch, and depth required to fit insulation thickness indicated.
- F. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

2.04 ACCESSORIES

- A. Metal Panel Accessories: Provide components required for a complete metal panel assembly including trim, copings, fascia, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal wall panels.
 - 1. Closures: Provide closures at eaves and rakes, fabricated of same metal as metal wall panels.
 - 2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
- B. Flashing and Trim: Formed from 0.0209 inch- thick, aluminum pre-anodized or prepainted with coil coating. 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, fascia, parapet caps, soffits, reveals, and filler panels. Finish flashing and trim with same finish system as adjacent metal panels.
- C. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads.
 - 1. Fasteners for 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. Exposed Fasteners where allowed: Stainless steel.

2.05 SHEET UNDERLAYMENT MATERIALS

- A. Sheet Membrane Underlayment: ASTM D1970, SBS-modified bituminous, high-temperature resistant, self-adhering, laminated polyethylene sheet membrane, minimum 40 mils thick. Acceptable manufacturers include:
 - 1. Lastobond Shield HT; Soprema, Inc.
 - 2. WIP 300HT; Carlisle WIP Products.
 - 3. Airluk Sheet 400 HT/NP; Polyguard Products.
 - 4. Grace HT; Grace Construction Products.
 - 5. Vulkem HT; Tremco Construction Products.
 - 6. Blueskin PE200HT; Henry Company.

2.06 FABRICATION

- A. General: Fabricate and finish metal wall panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes. 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.
 - 3. Fabricate metal panels in a manner that eliminates condensation on interior side of panel and with joints between panels designed to form weathertight seals.
- B. Metal-Faced Composite Panels: Factory form panels in a continuous process by laminating each sheet using manufacturer's proprietary bonding system. Trim and square edges of sheets with no displacement of face sheets or protrusion of core material.
 - 1. Dimensional Tolerances:
 - a. Length: Plus 0.375 inch.
 - b. Width: Plus 0.188 inch.
- C. Sheet Metal Accessories: Fabricate flashing and trim as indicated or where not indicated in accordance with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of item indicated.
 - 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
 - 2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
 - 3. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
 - 4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.

2.07 FINISHES ON ALUMINUM PANELS AND TRIM

- A. Application of coated finishes shall comply with AAMA 605.2 "Specification for High Performance Organic Coatings on Architectural Aluminum Extrusions and Panels".
- B. Surfaces shall match the appearance, color and sheen of samples submitted and approved, including jobsite mock-ups.
 - 1. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces or other components and trim are acceptable if they are within one-half of the range of approved Samples, when viewed under a uniform light source such as north daylight.
 - 2. The surface quality of the finished coating shall be smooth and free of streaks and imperfections. The coating shall be opaque and uniform in color and tonality.
 - 3. All finishes exposed to view shall be finished. No mill finish aluminum shall be permitted as an exposed finish.

- C. Three-Coat PVDF Finish Coating: Factory applied 3-coat, thermocured system consisting of specially formulated primer and fluoropolymer color topcoat containing not less than 70% polyvinylidene fluoride resin by weight. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2605.
 - 1. Primer: compatible with color coat, not less than 0.2 mils thick.
 - 2. Metallic Color Coating: 70% Kynar PVDF, not less than 0.7 mils thick.
 - 3. Clear Barrier Coating: medium gloss, not less than 0.4 mils thick.
 - 4. Finish Color: Matte Gray
 - 5. Approved Coating Manufacturers:
 - a. Duranar; PPG Industries, Inc.
 - b. Fluoropon; Valspar Corp.
 - c. Trinar; AkzoNobel

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of work.
 - 1. Examine primary and secondary wall framing to verify that sub-girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal panel manufacturer.
 - 2. Examine solid wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal panel manufacturer.
 - 3. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
- B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal wall panels before metal panel installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Clean substrates of substances, including removing projections capable of interfering with panel attachment.

3.03 UNDERLAYMENT INSTALLATION

- A. Install underlayment membrane over exterior face of exterior wall substrate in accordance with manufacturer recommendations.
- B. Start membrane installation at corners, leaving 6-12 inches of membrane to overlap.
 - 1. Install membrane in a horizontal manner starting at the lower portion of the wall surface with subsequent layers installed in a shingling manner to overlap lower layers.
 - 2. Seal seams of membrane with seam tape at all vertical and horizontal overlapping seams.
 - 3. Seal any tears or cuts as recommended by weather barrier manufacturer.

3.04 METAL PANEL INSTALLATION

- A. General: Install attachment system required to support metal panels in accordance with approved submittals, including subgirts and anchor channels.
 - 1. Attach panel sub-girt system directly to face of concrete panel substrate. Coordinate sub-girt spacing with panel clip locations.
 - 2. Shim or otherwise plumb sub-girt furring receiving metal panels.

3. Install flashing and trim as metal panel work proceeds, providing for thermal expansion of exposed flashing and trim.

3.05 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align metal panel units within installed tolerance of 1/4 inch in 20 feet, nonaccumulative, on level, plumb, and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.06 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal wall panel manufacturer. Maintain in a clean condition during construction.
- B. After panel installation, clear weep holes and drainage channels of obstructions and sealant.
- C. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

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SECTION 07 46 33

COMPOSITE CLAD SOFFIT PANELS

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes the following:
 - 1. Horizontal soffit cladding panels made from aluminum extrusions with resin composite cladding material.

1.02 SUBMITTALS

- A. Product Data: For each type of factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
- B. Samples for Approval: Samples to be submitted:
 - 1. Composite Panels: Three, 8-inch square samples of each type, color and texture.
 - 2. Trim Boards: Three, 12-inch samples of each type, color and texture.

1.03 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide metal panel assemblies capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated, based on testing according to ASTM E 330:
 - 1. Wind Loads: Determine loads based on the following minimum design wind-load design pressures, but not less than:
 - a. Uniform pressure of 15lbf/sq. ft., acting inward or outward.
 - 2. Deflection Limits: Design panel assemblies to withstand test pressures with deflection no greater than 1/240 of the span and no evidence of material failure, structural distress, or permanent deformation exceeding 0.2 percent of the clear span.

1.04 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Fabricator of resin clad wall panel system.
 - 1. Engineering Responsibility: Preparation of data for metal panels, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project and meeting the performance requirements specified.
- B. Installer Qualifications: Certified by panel manufacturer to fabricate and install manufacturer's wall panel system.
 - 1. Installer's responsibilities include fabricating and installing composite panel sub-assemblies and providing professional engineering services needed to assume engineering responsibility.

PART 2 - PRODUCTS

2.01 SOFFIT PANELS

- A. Composite Panels: Composite aluminum extrusions with UV-stabilized, thermoplastic cladding material, consisting of phenolic resin coatings, laminated under heat and pressure, into flat panels, with the following physical properties:
 - 1. Aluminum: Extruded 6063 T6 aluminum alloy, ASTM B 221.

2. Flame Spread: ASTM E 84; Class A.
3. Manufacturer: Vertigo 5010 Wood Hybrid Cladding as manufactured by Geolam.
 - a. Panel Thickness: 1/2-inch.
 - b. Nominal Size: 6 1/2" wide x 144" length.
 - c. Fastening: concealed fastening, interlocking seam.
 - d. Face surface: wood grain cladding
 - e. Color: Teak
- B. Attachment System Components: Formed from extruded aluminum.
 1. Include manufacturer's standard subgirts, perimeter extrusions, tracks, and drainage channels, panel stiffeners, panel clips and anchor channels.
 2. Flashing and Trim: Same cladding color as adjacent composite panels, minimum 0.030 inch thick, unless otherwise indicated.
- C. Available Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
 1. T&G Planks; Longboard Architectural Products.
 2. Mosaic Planks; RollFab Lumabuilt.

2.02 FASTENERS

- A. General: ASTM F 593, stainless steel threaded-screw fasteners of size recommended by composite wood manufacture.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of work.
 1. Examine primary and secondary soffit framing to verify that studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by composite panel manufacturer.
- B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before metal panel installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 COMPOSITE CLADDING PANEL INSTALLATION

- A. General: Install attachment system required to support composite panels in accordance with approved submittals, including subgirts, perimeter extrusions, panel clips, and anchor channels.
 1. Shim or otherwise plumb substrates receiving composite panels.
 2. Attach panel sub-girt system to metal subframing.
 3. Install flashing and trim as panel work proceeds.

END OF SECTION

SECTION 07 54 23

TPO MEMBRANE ROOFING

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes the following:
 - 1. Mechanically-fastened single-ply membrane roofing system.
 - 2. Above-deck insulation board.
- B. Related Sections include the following:
 - 1. Section 06 10 50 for "Rough Carpentry" for wood nailers, curbs, and blocking.
 - 2. Section 07 21 16 for "Building Insulation" for insulation beneath the roof deck, if any.
 - 3. Section 07 92 00 for "Joint Sealants."

1.02 PERFORMANCE REQUIREMENTS

- A. General: Provide installed roofing membrane and base flashings that remain watertight; do not permit the passage of water; and resist specified wind-uplift pressures, thermally induced movement, and exposure to weather without failure.
- B. Material Compatibility: Provide roofing materials that are compatible with one another for application required, as demonstrated by roofing membrane manufacturer based on testing and field experience.
- C. Roofing System Design: Provide a membrane roofing system that has been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to ASCE 7 and IBC 1609, Exposure C, Category II, Basic Wind Speed of 115 mph, with a safety factor of 1.2. The minimum uplift load capacity of the roof membrane and insulation or substrate board system shall be:
 - 1. Roof Area Field: -25.5 psf.
 - 2. Roof Area Perimeter: -38.2 psf, 16-ft width.

1.03 SUBMITTALS

- A. Product Data: Submit manufacturer's literature and technical specifications for each type of product.
- B. Shop Drawings: For roofing system. Include plans, details, and attachments to other Work.
 - 1. Flashings and membrane terminations.
 - 2. Insulation board and membrane fastening patterns.
- C. Certificates:
 - 1. Evidence of UL, ICBO and FMG ratings, as applicable to the Project.
 - 2. Installer Certificates: Signed by roofing system manufacturer certifying that Installer is approved, authorized, or licensed by manufacturer to install roofing system.
 - 3. Manufacturer's Letter of Certification that their products meet and comply with the materials and intent of the Specification, and manufacturer's installation instructions.
 - 4. At Project close-out, provide manufacturer's representative(s) certifications that products approved are products installed on the Project.
- D. Inspection Reports: Roofing manufacturer's reports of inspections and completed roofing installation.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's warranty.
- B. Manufacturer Qualifications: A qualified manufacturer that has UL listing for membrane roofing system identical to that used for this Project.
- C. Source Limitations: Obtain components for membrane roofing system approved by roofing membrane manufacturer.
- D. Fire-Test-Response Characteristics: Provide membrane roofing materials with the fire-test-response characteristics indicated as determined by testing identical products per test method below by UL, or other testing agency acceptable to authorities having jurisdiction. Materials shall be identified with appropriate markings of applicable testing and inspecting agency.
 - 1. Exterior Fire-Test Exposure: ASTM E 108, Class C, over combustible decking.
- E. Pre-Installation Conference:
 - 1. Prior to commencement of roofing installation and associated work, schedule a meeting with General Contractor, roofing system manufacturer's representative, and affected trades to review procedures related to roofing work, including but not necessarily limited to the following:
 - a. Review structural loading limitations of roof deck construction, and inspect deck for loss of flatness and for required attachment.
 - b. Review roofing system requirements (drawings, specifications and other Contract Documents).
 - c. Review required inspections, testing and certifications required to provide warranty compliance.
 - d. Review Flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
 - e. Review governing regulations and requirements for insurance and certificates if applicable.
 - f. Review temporary protection requirements for roofing system during and after installation.
 - 2. Contractor shall submit to Architect documentation of revised materials, installation details or other information, at variance from approved submittals.
 - 3. Contractor shall prepare minutes of the meeting and furnish copy of record to each party attending, to Architect and Owner.
 - 4. Provide schedule of roofing installation inspections performed by roof membrane manufacturer. Distribute subsequent written reports of observations to Architect and Owner.

1.05 STORAGE AND HANDLING

- A. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer.
 - 1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
- B. 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.

1.06 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.07 WARRANTY

- A. Roofing Manufacturers Warranty: Manufacturer's standard form, 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. Failure includes roof leaks.

1. Warranty includes all components of membrane roofing system such as roofing membrane, base flashing, roof insulation, fasteners, cover boards, substrate boards, and walkway products that fail within the specified warranty period.
 2. Warranty Period: 30 years from date of installation completion.
- B. Roofing Installer's Warranty: Submit roofing Installer's warranty, signed by Installing Contractor, covering Work of this Section, including all components of roofing system for the following warranty period:
1. Warranty Period: Two years from date of Substantial Completion.

PART 2 = PRODUCTS

2.01 THERMOPLASTIC POLYOLEFIN ROOFING MEMBRANE

- A. Fabric-Reinforced Thermoplastic Polyolefin Sheet: ASTM D 6878, uniform, flexible sheet formed from a thermoplastic ethylene-propylene polyolefin, internally fabric or scrim reinforced, and as follows:
1. Acceptable Manufacturers:
 - a. Firestone Building Products; Ultraply TPO.
 - b. Carlisle SynTec Inc; Sure-Weld TPO
 - c. Johns Manville; JM TPO.
 2. Thickness: 60 mils, nominal.
 3. Exposed Face Color: White.
 4. Physical Properties:
 - a. Breaking Strength: 360 lbf; ASTM D 751, grab method.
 - b. Puncture Resistance: 350 lbf; FTM 101C Method 2013.
 - c. Elongation Break of Scrim Reinforcement: 15 percent minimum; ASTM D 751.
 - d. Tearing Strength: 130 lbf minimum; ASTM D 751, Procedure B.
 - e. Field Seam Strength: 60 lbf/in ASTM D 1876, peel method.

2.02 AUXILIARY MATERIALS

- A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with membrane roofing.
1. Liquid-type auxiliary materials shall meet VOC limits of authorities having jurisdiction.
- B. Sheet Flashing: Manufacturer's sheet flashing of same material, type, reinforcement, thickness, and color as sheet membrane.
- C. Sheet Metal Flashing: ASTM A 653, 24 ga., G60 coating designation; structural quality, mill phosphatized to receive manufacturers proprietary TPO coating.
- D. Bonding Adhesive: Manufacturer's standard solvent based bonding adhesive for membrane, and solvent-based bonding adhesive for base flashings.
- E. Metal Termination Bars: Manufacturer's standard predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.
- F. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening membrane to substrate, and acceptable to membrane roofing system manufacturer.
- G. Miscellaneous Accessories: Provide preformed cone vent flashings, preformed inside and outside corner sheet flashings, T-joint covers, termination reglets, cover strips, and other accessories.

2.03 INSULATION BOARD

- A. General: Provide preformed roof insulation boards manufactured or approved by roofing membrane manufacturer, selected from manufacturer's standard sizes suitable for application of thicknesses required to achieve thermal insulation performance of R-30 above roof deck.
 - 1. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, U.L. Class A, fire-resistant coated glass-fiber mat facer on both surfaces with an aged R-value of not less than R-5.6 per inch thickness.
 - a. Minimum Compressive Strength: 20 psi.
 - b. Maximum Board Thickness: 2 1/2-inch.
 - c. Maximum Board Size: 48 inch by 96 inch.
- B. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes fabricated to maintain minimum drainage slope of 1/4 inch fall in 12 inches of run.

2.04 ACCESSORIES

- A. Provide preformed insulation board saddles, crickets, tapered edge strips, and other insulation shapes fabricated to maintain minimum drainage slope of 1/4 inch fall in 12 inches of run.
- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer. Provide specialty fasteners or increased spacing where OSB sheathing alternates are accepted by Owner.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions: Examine subsurfaces to receive Work and report detrimental conditions.
 - 1. Prior to the application of roofing materials, the Contractor shall examine the roof deck insulation board, crickets, flashings, and other surfaces receiving roofing materials to ensure that surfaces are clean, primed and in proper condition to receive the roofing system.
 - 2. All penetrations through roofing, including drains, scuppers, pipe, vent and electrical conduit penetrations shall be completed prior to the starting of membrane application.
 - 3. The Contractor shall report in writing to the Owner any condition unacceptable to the Contractor's proper installation of roofing materials prior to proceeding with the work.
 - a. Application of roofing materials shall constitute the roofing Contractor's acceptance of surfaces and flashings to receive roofing materials.

3.02 INSULATION BOARD INSTALLATION

- A. Coordinate installing membrane roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.
- B. Comply with membrane roofing system manufacturer's written instructions for installing insulation.
 - 1. Secure first layer of insulation to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.
 - a. Space fastener placement to resist design uplift pressure at corners, perimeter, and field of roof, in accordance with ASCE 7.
 - 2. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Cut and fit insulation within 1/4 inch of vertical surfaces, nailers, projections, and penetrations.

3.03 MECHANICALLY ATTACHED MEMBRANE INSTALLATION

- A. Install roofing membrane over areas to receive roofing according to membrane roofing system manufacturer's written instructions. Unroll roofing membrane to relax before installing.
 - 1. Roof membrane shall be unrolled on the area to be covered so that side seams are perpendicular to metal deck flutes. Accurately align roofing membrane and maintain uniform side and end laps of minimum dimensions required by manufacturer.
 - 2. Mechanically fasten roofing membrane securely at edge terminations, penetrations, and perimeter of roofing, pulling membrane taut to eliminate wrinkles or bubbles.
 - 3. Clean seam surfaces, over lapping fastener plates, and weld seams using manufacturers approved hot-air welding equipment and methods to secure seams.
 - 4. Apply continuous cut-edge sealant bead along seam edges.

3.04 FLASHING INSTALLATION

- A. Install perimeter flashings and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions.
 - 1. Apply bonding adhesive to substrate and underside of sheet flashing at a rate of approximately one gallon per 60 square feet of surface coverage and allow to partially dry.
 - 2. Terminate and seal top of perimeter flashings with manufacturer's standard pressure-bar. Provide pre-molded inside and outside corners terminations.
 - 3. Flash penetrations with manufacturer's standard pre-molded boots.
 - 4. Clean seam areas and overlap and firmly roll sheet flashings into the adhesive. Weld side and end laps to ensure a watertight seam installation.
- B. Roof Drains: Set metal flashing in bed of roofing sealant over roofing membrane in accordance with manufacturer's details. Cover metal flashing with roofing membrane sheet stripping and extend a minimum of 6 inches beyond edge of metal flashing onto field of roofing membrane. Clamp roofing membrane, metal flashing, and stripping into roof-drain clamping ring.
- C. Vertical Pipe Penetrations: At pipe projections extending above roof covering, turn roof membrane sheet up projection a minimum height of 4-inches. Cover termination with umbrella-type counter-flashing and secure with clamp-ring.
- D. Scuppers: Where thru-wall scuppers are indicated, install three-piece, 24 ga. sections in accordance with SMACNA Plate 26 details, unless otherwise indicated.

3.05 FIELD QUALITY CONTROL

- A. Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation as work progresses and on completion and submit reports to Architect.

3.06 PROTECTING AND CLEANING

- A. Protect membrane roofing system from damage and wear during remainder of installation period.
- B. Correct deficiencies in membrane roofing system that do not comply with requirements. Repair substrates or reinstall membrane roofing system to a condition free of damage and deterioration at time of completion and according to warranty requirements.
- C. Clean adhesives, overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

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SECTION 07 62 00

SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes the following sheet metal flashing and trim:
 - 1. Masonry parapet coping.
- B. Related Sections include the following:
 - 1. Section 07 54 23 for "TPO Membrane Roofing" for installing sheet metal flashing and trim integral with roofing membrane.
 - 2. Section 07 92 00 for "Joint Sealants" for field-applied sheet metal flashing and trim sealants.

1.02 PERFORMANCE REQUIREMENTS

- A. General: Install sheet metal flashing and trim to withstand wind loads, structural movement, thermal movement, and exposure to weather without failing, rattling, fastener disengagement and that does not allow water infiltration to building interior.

1.03 SUBMITTALS

- A. Product Data: For premanufactured items, include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

1.04 QUALITY ASSURANCE

- A. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual." Conform to dimensions and profiles indicated.

1.05 COORDINATION

- A. Coordinate installation of sheet metal flashing and trim with interfacing and adjoining construction to provide a leakproof, secure, and noncorrosive installation.

PART 2 - PRODUCTS

2.01 SHEET METALS

- A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653, 24 ga., G90 coating designation; structural quality, mill phosphatized for field painting.
- B. Aluminum Sheet: ASTM B 209M, 22 gage, mill-finish.

2.02 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation.

- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, with integral neoprene sealing-washers where exposed.
- C. Sealing Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape.
- D. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane or silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and remain watertight.

2.03 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated. Obtain field measurements for accurate fit before shop fabrication. Fabricate profiles to conceal fasteners and expansion provisions on exposed-to-view sheet metal flashing and trim, unless otherwise indicated.
- B. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA recommendations.
- C. Expansion Provisions: Where lapped or bayonet-type expansion provisions in the Work cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1-inch deep, filled with sealant concealed within joints.

2.04 ROOF SHEET METAL FABRICATIONS

- A. Copings, Edge Flashing and Fascia Caps: Fabricate from 24 gage, galvanized steel in minimum 96-inch long, but not exceeding 10-foot long sections. Furnish with 6-inch wide joint cover plates.
- B. Counterflashing and Recievers: Fabricate from 0.032 inch thick aluminum.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of work.
 - 1. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
 - 2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 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, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
- B. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated. Provide uniform, neat seams with minimum exposure of sealant. 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.
- C. Butt Joints: Provide 1/8 inch thick sealant joint for thermal expansion of exposed flashing and trim. At the end joint of each piece of trim or flashing, provide 8-inch wide interior butt strip under each sealant joint. Seal joints with silicone sealant as required for watertight construction.

- D. Fasteners: On sheet metal flashings and trim exposed to view on the exterior side of the building, provide concealed fasteners or clips. Where exposed fasteners are used, do not penetrate horizontal surfaces of flashings.
 - 1. Galvanized or Prepainted, Metallic-Coated Steel: Use cad-plated fasteners.
 - 2. Aluminum: Use aluminum or stainless-steel fasteners.
 - 3. Stainless Steel: Use stainless-steel fasteners.
- E. Aluminum Flashing: Rivet or weld joints in uncoated aluminum where necessary for strength.

3.03 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of sealants and substances that interfere with proper adhesion of paint or other coatings.
- B. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain in a clean condition during construction.
- C. 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.

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SECTION 07 72 00

ROOF ACCESSORIES

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes the following:
 - 1. Roof hatches.
- B. Related Sections include the following:
 - 1. Section 05 50 00 "Metal Fabrications" for ladders and miscellaneous metal framing and supports.

1.02 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, materials, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: Show fabrication and installation details. Indicate dimensions, weights, loadings, required clearances, method of field assembly, and components. Include plans, elevations, sections, details, and attachments to other Work.
- C. Coordination Drawings: Roof plans drawn to scale and coordinating penetrations and roof-mounted items. Show method of attaching roof accessories to roof membrane or building structure.
- D. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for roof accessories with factory-applied color finishes.

1.03 QUALITY ASSURANCE

- A. Standards: Comply with the following:
 - 1. SMACNA's "Architectural Sheet Metal Manual" details for fabrication of units, including flanges and cap flashing to coordinate with type of roofing indicated.
 - 2. NRCA's "Roofing and Waterproofing Manual" details for installing units.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- 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:
 - 1. Roof Hatches:
 - a. Babcock-Davis Hatchways, Inc.
 - b. Bilco Company.
 - c. Dur-Red Products, Inc.

2.02 MATERIALS, GENERAL

- A. Aluminum Sheet: ASTM B 209 for alclad alloy 3005H25 or alloy and temper required to suit forming operations, with mill finish, unless otherwise indicated.

- B. Galvanized Steel Sheet: ASTM A 653 with G90 coating designation; commercial quality, unless otherwise indicated.
- C. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M with Class AZ-50 coating, structural quality, Grade 40, or as required for strength.
- D. Insulation: Manufacturer's standard rigid or semirigid glass-fiber board of thickness indicated.
- E. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, complying with AWPA C2; not less than 1-1/2 inches thick.
- F. Fasteners: Same metal as metals being fastened, or stainless steel or other noncorrosive metal as recommended by manufacturer. Match finish of exposed fasteners with finish of material being fastened.
- G. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, or PVC; or flat design of foam rubber, sponge neoprene, or cork.
- H. Elastomeric Sealant: Generic type recommended by unit manufacturer that is compatible with joint surfaces; ASTM C 920, Type S, Grade NS, Class 25, and Uses NT, G, A, and, as applicable to joint substrates indicated, O.

2.03 ROOF HATCHES

- A. General: Fabricate units to withstand 40-lbf/sq. ft. external and 20-lbf/sq. ft. internal loading pressure. Frame with minimum 12-inch- high, integral-curb, double-wall construction with 1-1/2-inch insulation, formed cants and cap flashing (roofing counterflashing), with welded mechanical corner joints. Provide double-wall cover (lid) construction with 1- inch- thick insulation core. Provide gasketing and equip with corrosion-resistant hardware including pintle hinges, hold-open devices, interior padlock hasps, and both interior and exterior latch handles.
- B. Type: Single-leaf personnel access.
 - 1. For Ladder Access: Bilco Model: Type E-20 (36 by 36 inches).
 - 2. Material: 14 ga. steel sheet curbs and cover.
 - 3. Finish: Galvanized.
- C. Fall Protection: 1 1/4" Schedule 40 aluminum pipe rail assembly with post clamp-supports mounted to corners of roof-hatch curb flange.
 - 1. Rail Height: 42-inches above roof surface.
 - 2. Gate Hardware: Stainless-steel, self-closing spring hinges and latch.
 - 3. Finish: Powder-coated "Safety-Yellow".
 - 4. Approved Manufacturer: Bilco Model: Bil-Guard 2.0
- D. Safety Post Extension: Telescoping steel pipe assembly, secured to ladder rungs.
 - 1. Rail Height: 30-inches above roof surface.
 - 2. Hardware: Stainless-steel, spring latch.
 - 3. Finish: Powder-coated "Safety-Yellow".
 - 4. Approved Manufacturer: Bilco Model: LU-1.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General: Comply with manufacturer's written instructions. Coordinate installation of roof accessories with installation of roof deck, roof insulation, flashing, roofing membranes, penetrations, equipment, and other construction involving roof accessories to ensure that each element of the Work performs properly and that combined elements are waterproof and weathertight. Anchor roof accessories

securely to supporting structural substrates so they are capable of withstanding lateral and thermal stresses, and inward and outward loading pressures.

- B. Install roof accessory items according to construction details of NRCA's "Roofing and Waterproofing Manual," unless otherwise indicated,
- C. Flange Seals: Unless otherwise indicated, set flanges of accessory units in a thick bed of roofing cement to form a seal.

3.02 CLEANING AND PROTECTION

- A. Clean exposed surfaces according to manufacturer's written instructions. Touch up damaged metal coatings.

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SECTION 07 92 00

JOINT SEALANTS

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes sealants for the following applications:
 - 1. Exterior joints in the following vertical surfaces and nontraffic horizontal surfaces:
 - a. Control joints in concrete tilt-panel construction.
 - b. Joints between steel framing and tilt-panels.
 - c. Joints between metal panels and trim.
 - d. Perimeter joints of door and window frames.
 - e. Control and expansion joints in soffits and overhead surfaces.
 - f. Joints between different materials and other joints as indicated.
 - 2. Exterior joints in the following horizontal traffic surfaces:
 - a. Control and expansion joints in concrete pavements.
 - 3. Interior joints in the following vertical surfaces:
 - a. Wall joints in concrete tilt-panel construction.
- B. Related Sections include the following:
 - 1. Section 03 30 00 for "Cast-in-Place Concrete" for joint filler sealants in concrete floor slabs.
 - 2. Section 08 80 00 for "Glass and Glazing" for glazing sealants.

1.02 PERFORMANCE REQUIREMENTS

- A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.
- B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

1.03 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated and manufacturer's color charts.
- B. Product Certificates: Signed by manufacturers of joint sealants certifying that products furnished comply with requirements and are suitable for the use indicated.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this Project and whose work has resulted in joint-sealant installations with a record of successful in-service performance.

1.05 PROJECT CONDITIONS

- A. Joint-Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.

1.06 WARRANTY

- A. Warranty: Provide written warranty, signed by Installer and sealant manufacturers agreeing to repair or replace joint sealants at no additional cost to Owner because of loss of adhesion or cohesion, do not cure or fail to meet other performance requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Three years from date of Substantial Completion.
- B. Warranties specified in this Article exclude deterioration or failure of joint sealants caused from the following:
 - 1. Joint movement of the structure exceeding sealant manufacturer's written specifications for sealant elongation and compression caused by structural settlement or movement attributable to design or construction.
 - 2. Mechanical damage caused by individuals, tools, or other outside agents.
 - 3. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.01 MATERIALS, GENERAL

- A. Single Source: Provide materials and sealants for each sealant type from a single manufacturer. Where sealants from different manufacturers are in contact with one another, provide written compatibility statements from each manufacturer.
- 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 sealant manufacturer based on testing and field experience.
- C. Materials: Primers, backer materials, joint fillers, bond breakers, cleaners and related materials shall be compatible with and as recommended by each respective sealant manufacturer.
- D. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and capable of being removed without damage to adjacent surfaces.

2.02 ELASTOMERIC JOINT SEALANTS

- A. Elastomeric Sealant Standard: Comply with requirements indicated for each liquid-applied chemically curing sealant in the Elastomeric Joint-Sealant Schedule at the end of Part 3, including those referencing ASTM C 920 classifications for type, grade, class, and uses.
- B. Colors of Exposed (unpainted) Joint Sealants:
 - 1. Traffic Joints: As selected from manufacturer's full range of standard colors.
 - 2. Perimeter Window Framing Joints: As selected from manufacturer's full range of standard colors.
 - 3. Masonry, EIFS and Tilt-Panel Joints: Custom color tinted to match adjacent wall material colors.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine joints indicated to receive joint sealants for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Window System Perimeter Joint Width: Verify with window system installer that rough openings and fabrication of framing systems will ensure perimeter sealant joint widths do not exceed 3/4 inch or are less than 3/8 inch in width.

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, blast cleaning, 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 from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air. Porous joint surfaces include; concrete, masonry and unglazed surfaces of tile.
 - 3. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Non-porous joint surfaces include; metal, glass, porcelain enamel and glazed surfaces of tile.
- B. Joint Priming: Prime joint substrates where recommended in writing by joint sealant manufacturer. 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 with adjoining surfaces. 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. Comply with recommendations of ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- B. Acoustical Sealant Application Standard: Comply with recommendations of ASTM C 919 for use of joint sealants in acoustical applications as applicable to materials and conditions indicated.
- C. Install sealant backings of type 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.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and back of joints.
- E. Install sealants to 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 provided for each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability. Remove excess sealants from surfaces adjacent to joint.
- F. Tooling of Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants to form smooth, uniform beads of concave configuration; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
- G. Traffic Joints: Dust traffic joints with mica sand before sealant has formed a skin.

3.04 FIELD QUALITY CONTROL

- A. Field Water-Penetration Testing: At Owner's option and cost, random testing of joints may be done, using a continuous hose-stream technique. If uncontrolled water is observed on the interior, after initial hose-stream test, additional testing and remedial measures will be required.

3.05 CLEANING

- A. Clean excess sealants or sealant smears adjacent to joints by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.06 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.

3.07 ELASTOMERIC JOINT-SEALANT SCHEDULE

- A. Concrete Pavements: Single-component, non-tracking, self-leveling, polyurethane sealant meeting FS TT-S-00230C Type I, Class A and ASTM C 920 Type S, Class 25, Grade P with a Shore A of 25 or better upon curing.
 - 1. Joint Movement: plus or minus 25% of joint width.
 - 2. Use Related to Exposure: T (traffic)
 - 3. Applications: Driveways, sidewalks and truckcourt pavements (tooled or saw-cut) joints.
 - 4. Approved Manufacturers:
 - a. MasterSeal SL1; MBCC Group (BASF)
 - b. Sikaflex-1c SL; Sika Corp.
 - c. Vulkem 45 SSL; Tremco
- B. Metal Panels and Window Framing: Medium-modulus, neutral-cure silicone rubber sealant meeting FS TT-S-00230C, Class A, and/or ASTM C 920 Type S, Class 50, Grade NS with a Shore A of 15 upon curing.
 - 1. Joint Movement: plus or minus 50% of joint width.
 - 2. Use Related to Exposure: NT (non-traffic)
 - 3. Applications: Metal to metal, perimeter window/door frames, and metal to concrete joints.
 - 4. Approved Manufacturers:
 - a. MasterSeal 122; MBCC Group (BASF)
 - b. Sikasil; WS-295; Sika Corp.
 - c. Spectrum 2; Tremco
 - d. Pecora 864; Pecora Corp.
- C. Concrete Tilt-panels: Multi-component, non-staining, (tint grade) hybrid-polymer sealant meeting FS TT-S-00227E, Type II, Class A and ASTM C 920 Type M, Class 25, Grade NS with a Shore A of 25 upon curing.
 - 1. Joint Movement: plus or minus 50 % of joint width.
 - 2. Use Related to Exposure: NT (non-traffic)
 - 3. Applications: Vertical concrete tilt-panel control joints.
 - 4. Approved Manufacturers:
 - a. MasterSeal NP-100; MBCC Group (BASF)
 - b. Dymeric 240FC; Tremco
 - c. DynaTrol II; Pecora Corp.

END OF SECTION

SECTION 08 11 00

HOLLOW-METAL DOORS AND FRAMES

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes the following:
 - 1. Hollow-metal insulated steel doors.
 - 2. Hollow-metal steel door frames.
- B. Related Sections include the following:
 - 1. Section 08 71 00 for "Door Hardware" for door hardware and weather stripping.
 - 2. Section 09 91 13 for "Painting" for field painting factory-primed doors and frames.

1.02 SUBMITTALS

- A. Product Data: For each type of door and frame indicated, include door designation, type, level and model, material description, core description, construction details, label compliance, sound and fire-resistance ratings, and finishes.
- B. Shop Drawings: Show the following:
 - 1. Elevations and frame details for each frame type including dimensioned profiles.
 - 2. Details of anchorages, accessories, joints, and connections.

1.03 QUALITY ASSURANCE

- A. Steel Door and Frame Standard: Comply with ANSI/SDI A 250.8, unless more stringent requirements are indicated.
- B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver doors and frames cardboard-wrapped or crated to provide protection during transit and job storage. Provide additional protection to prevent damage to finish of factory-finished doors and frames. Remove and replace damaged items that cannot be repaired as directed.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- 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:
 - 1. Steel Doors and Frames:
 - a. Imperial/Legion/Regent Composite Doors; Ceco Door Products.
 - b. L-18 Series; Steelcraft; Allegion Brands.
 - c. C/CM Series; Curries AADG, Inc.

2.02 MATERIALS

- A. Steel Sheets: ASTM A 924 - Specification for General Requirements for Steel Sheet, Metallic-coated by the Hot-Dip Process.
- B. Cold-Rolled Steel Sheets: ASTM A 366, Commercial Steel (CS), or ASTM A 620, Drawing Steel (DS), Type B; stretcher-leveled standard of flatness.
- C. Electrolytic Zinc-Iron Coated Steel Sheet: ASTM A 653 - Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process. Commercial Steel (CS), A40 or A60 coating; mill phosphatized; suitable for exposed applications; stretcher-leveled standard of flatness for face sheets.

2.03 DOORS

- A. Doors: Provide doors of sizes indicated, 1 3/4" thickness, complying with requirements indicated below by referencing ANSI A250.8 for level and model and ANSI A250.4 for physical-endurance level:
 - 1. Exterior Doors: 18 gauge, ASTM A 653, A-60 galvannealed steel, Level 2, Performance Level B (Heavy Duty), Model 2, seamless epoxy-filled edges.
 - 2. Interior Doors: 20 gauge, ASTM A 653, A-40 galvannealed steel, Level 1, Performance Level C (Standard Duty), Model 1, full-flush edges.
- B. Door Louvers: Provide louvers for exterior doors, where indicated, that comply with SDI 111C, with blades or baffles formed of 0.020-inch- thick, cold-rolled steel sheet set into 0.032-inch- thick steel frame.

2.04 FRAMES

- A. Door Frames: Provide steel frames for doors, transoms and other openings that comply with ANSI A250.8 and with details indicated for type and profile. Conceal fastenings, unless otherwise indicated.
 - 1. Exterior Frames: 16 gauge, A-60 galvanized steel, continuously welded seamless corners.
 - 2. Interior Frames: 16 gauge, A-40 galvanized steel, continuously welded seamless corners.
 - 3. Fire Rating Labels: Provide frame units bearing Labels for ratings as scheduled on Drawings.
- B. Door Silencers: Except on weather-stripped frames, fabricate stops to receive three silencers on strike jambs of single-door frames and two silencers on heads of double-door frames.
- C. Supports and Anchors: Fabricated from not less than 0.056-inch- thick, electrolytic zinc-coated or metallic-coated steel sheet.
- D. Inserts, Bolts, and Fasteners: Manufacturer's standard units. Where zinc-coated items are to be built into exterior walls, comply with ASTM A 153, Class C or D as applicable.

2.05 FABRICATION

- A. General: Fabricate steel door and frame units to comply with ANSI A250.8 and to be rigid, neat in appearance, and free from defects including warp and buckle. Where practical, fit and assemble units in manufacturer's plant. Clearly identify work that cannot be permanently factory assembled before shipment, to assure proper assembly at Project site.
- B. Exterior Door Construction: For exterior locations and elsewhere as indicated, fabricate doors, panels, and frames from galvanized steel sheet. Close top and bottom edges of doors flush as an integral part of door construction or by addition of heavy-gauge, metallic-coated steel channels with channel webs placed even with top and bottom edges.

- C. Door Core Construction: Manufacturer's standard core construction that produces a door complying with SDI standards, and as follows:
 - 1. Polystyrene Core: Full 1 3/4-inch thick rigid polystyrene foamboard laminated to inside faces of door panels with waterproof adhesive. Minimum R-Value: 2.6 per inch thickness.
- D. Clearances for Non-Fire-Rated Doors: Not more than 1/8 inch at jambs and heads, except not more than 1/4 inch between pairs of doors. Not more than 3/4 inch at bottom.
- E. Clearances for Fire-Rated Doors: As required by NFPA 80.
- F. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."
- G. Exposed Fasteners: Unless otherwise indicated, provide countersunk flat or oval heads for exposed screws and bolts.
- H. Thermal-Rating: At exterior locations and elsewhere as shown or scheduled, provide doors fabricated as thermal-insulating door assemblies and tested according to ASTM C 236 or ASTM C 976 on fully operable door assemblies.
- I. Hardware Preparation: Prepare doors and frames to receive mortised and concealed hardware according to final door hardware schedule and templates provided by hardware supplier. Comply with applicable requirements in ANSI A250.6 and ANSI A115 Series specifications for door and frame preparation for hardware.
- J. Frame Construction: Fabricate frames to profiles shown. Fabricate frames with mitered and continuously welded seamless corners and face joints.
- K. Reinforce doors and frames to receive surface-applied hardware. Locate hardware as indicated on Shop Drawings. Drilling and tapping for surface-applied hardware may be done at Project site.

2.06 FINISHES

- A. Prime Finish: Manufacturer's standard, factory-applied coat of rust-inhibiting primer complying with ANSI A250.10 for acceptance criteria.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General: Install steel doors, frames, and accessories according to Shop Drawings, manufacturer's data, and as specified.
- B. Placing Frames: Comply with provisions in SDI 105, unless otherwise indicated. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders, leaving surfaces smooth and undamaged.
 - 1. In cast-concrete construction, provide at least three completed opening anchors per jamb; install adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb. Set frames and secure to adjacent construction with bolts and masonry anchorage devices. For openings 90 inches or more in height, install an additional anchor at hinge and strike jambs.
- C. Door Installation: Comply with ANSI A250.8. Fit hollow-metal doors accurately in frames, within clearances specified in ANSI A250.8. Shim as necessary to comply with SDI 122 and ANSI/DHI A115.1G.

3.02 ADJUSTING AND CLEANING

- A. Prime-Coat Touchup: Immediately after installation, sand smooth any rusted or damaged areas of prime coat and apply touch up of compatible air-drying primer.

END OF SECTION

SECTION 08 36 00

OVERHEAD SECTIONAL DOORS

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes the following types of sectional overhead doors:
 - 1. Manual-lift insulated steel panel doors.
 - 2. Motor-operated insulated steel panel doors.
 - 3. Tracks configured for the following lift types:
 - a. Standard, vertical high-lift.
- B. Related Sections include the following:
 - 1. Section 09 91 13 for "Painting" for field-applied paint finish, if any.

1.02 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide sectional overhead doors capable of withstanding the effects of gravity loads and the following loads and stresses without evidencing permanent deformation of door components:
 - 1. Wind Load: Uniform pressure (velocity pressure) of 15 lbf/sq. ft., acting inward and outward.
- B. Operation-Cycle Requirements: Design sectional overhead door components and operator to operate for not less than 10,000 cycles.

1.03 REFERENCES

- A. American Society of Civil Engineers/Structural Engineering Institute (ASCE/SEI).
 - 1. ASCE/SEI 7: Minimum Design Loads for Buildings and Other Structures.
- B. Door & Access Systems Manufacturers Association International (DASMA).
 - 1. DASMA 102: Specification for Sectional Doors (ANSI).
 - 2. DASMA 105: Test Method for Thermal Transmittance and Air Infiltration of Garage Doors (ANSI).
 - 3. DASMA 163: R-value and U-factor as Applied to Residential or Commercial Garage Doors.

1.04 SUBMITTALS

- A. Product Data: For each type and size of sectional overhead door and accessory. Include details of construction relative to materials, dimensions of individual components, profiles, and finishes. Provide roughing-in diagrams, operating instructions, and maintenance information. Include the following:
 - 1. Setting drawings, templates, and installation instructions for built-in or embedded anchor devices.
 - 2. Motors: Show nameplate data and ratings; characteristics; mounting arrangements; size and location of winding termination lugs, conduit entry, and grounding lug; and coatings.
 - 3. Wiring Diagrams: Detail wiring for power, signal, and control systems. Differentiate between manufacturer-installed and field-installed wiring and between components provided by door manufacturer and those provided by others.
- B. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for units with factory-applied finishes.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer who is an authorized representative of the sectional overhead door manufacturer for both installation and maintenance of units required for this Project.

1.06 WARRANTY

- A. Special Assembly Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door systems that do not comply with requirements or that deteriorate as defined in this Section within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Deterioration of metals, metal finishes, gaskets and other materials beyond normal weathering.
 - c. Water leakage through fixed glazing.
 - d. Cohesive or adhesive insulation bond failure to panel faces.
 - e. Failure of operating components to function properly.
 - 2. Warranty Period:
 - a. Motors: Five (5) years from date of Substantial Completion.
 - b. Insulated Doors: Two (2) years from date of Substantial Completion.
 - c. Non-insulated Doors: One (1) year from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 INSULATED STEEL DOOR SECTIONS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:
 - 1. 426 Series; Overhead Door Corporation.
 - 2. 524S Series; Clopay Building Products Co.
 - 3. Amarr 2422 Series; Entrematic Group.
 - 4. Insul-Rite 5225; Rite-Hite Doors.
- B. Construct door panel sections from galvanized, structural-quality carbon-steel sheets complying with ASTM A 653, commercial quality, with a minimum yield strength of 33,000 psi and a minimum G60 zinc coating.
 - 1. Panel Section Thickness: 2-inch.
 - 2. Exterior Section Face Profile: 24-gauge, embossed texture, ribbed horizontal pattern.
 - 3. Interior Section Face Profile: 26-gauge, embossed texture, flat.
 - 4. Panel Insulation: Expanded Polystyrene; Minimum R-value: R-6.5.
 - 5. Ramp Door Opening Size: 14'-0" wide x 16'-0" high.
 - a. Door Operation: Motorized.
 - 6. Dock Door Opening Size: 9'-0" wide x 10'-0" high.
 - a. Door Operation: Manual. 1/2" rope-pull hoist.
- C. Fabricate door panel faces from a single sheet to provide sections not more than 24 inches high. Roll horizontal meeting edges to a continuous, interlocking, tongue-in-groove weathertight seal, with a reinforcing flange return.
- D. Enclose panel end sections with not less than 18-gauge galvanized steel channel end stiles.
 - 1. Reinforce bottom section with a continuous channel or angle complying with bottom section profile and allowing installation of rubber astragal.
 - 2. Provide reinforcement and pre-punched holes for hardware attachment.
- E. Insulation: Insulate inner core of steel sections with foamed-in-place polyurethane or expanded polystyrene thermal insulation, with maximum flame-spread and smoke-developed indices of 75 and 450, respectively, according to ASTM E 84. Enclose insulation completely, with no exposed insulation material visible.

- F. Finish galvanized steel door sections with manufacturer's standard primer and baked polyester finish coats to interior and exterior door faces after forming, according to coating manufacturer's instructions for application, thermosetting, and minimum dry film thickness.
 - 1. Color: Selected from manufacturers standard line.

2.02 TRACKS, SUPPORTS, AND ACCESSORIES

- A. Tracks: Provide manufacturer's standard, 12-gauge, G60 galvanized steel track system, designed for vertical high-lift type design, and clearances shown. Provide complete track assembly including brackets, bracing, and reinforcement for rigid support of ball-bearing roller guides for required door type and size. Slope tracks at proper angle from vertical or otherwise design to ensure tight closure at jambs when door unit is closed. Bolt track to wall supports.
- B. Track Reinforcement and Supports: Provide galvanized steel track reinforcement and support members. Secure, reinforce, and support tracks as required for door size and weight to provide strength and rigidity without sag, sway, and vibration during opening and closing of doors.
- C. Support and attach tracks to opening jambs with continuous angle welded to tracks and attached to wall.
- D. Weatherseals: Provide replaceable, adjustable, continuous, compressible weather-stripping gaskets of flexible vinyl, rubber, or neoprene fitted to bottom and at top of overhead door.
 - 1. Provide motor-operated doors with combination bottom weatherseal and sensor edge.
- E. View Window: Provide 6-inch by 18-inch single-pane glass window with rubber gasket seals. Locate latch side of door.

2.03 HARDWARE

- A. General: Provide heavy-duty, corrosion-resistant hardware, with hot-dip galvanized, stainless-steel, or other corrosion-resistant fasteners, to suit door type.
- B. Hinges: Provide heavy-duty galvanized steel hinges, of not less than 14-gauge uncoated steel, at each end stile and at each intermediate stile, per manufacturer's written recommendations for door size. Attach hinges to door sections through stiles and rails with bolts and lock nuts or lock washers and nuts. Use rivets or self-tapping fasteners where access to nuts is not possible. Provide double-end hinges, where required, for doors exceeding 16 feet in width, unless otherwise recommended by door manufacturer.
- C. Rollers: Provide heavy-duty rollers, with steel ball bearings in case-hardened steel races, mounted with varying projections to suit slope of track. Extend roller shaft through both hinges where double hinges are required. Provide 2-inch- diameter roller tires and 2-inch track.
- D. Handles: 13-gauge galvanized steel step-plate/lifting handle on each side of bottom door panel.
- E. Slide Bolt: For manual-lift doors fabricate with side locking bolts to engage through slots in tracks for locking by padlock, located on single-jamb side, operable from inside only.
- F. Fabricate locking device assembly with lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bar to engage through slots in tracks.
 - 1. Locking Bars: Single-jamb right-side, operable from inside only.
 - 2. Provide safety interlock switch to disengage power supply when door is locked.

2.04 COUNTERBALANCING MECHANISM

- A. Torsion Spring: Operation by torsion-spring counterbalance mechanism consisting of adjustable-tension torsion springs, fabricated from oil-tempered-steel wire mounted on a cross-header tube or

steel shaft. Connect to door with galvanized aircraft-type lift cables with cable safety factor of at least 5 to 1. Provide springs calibrated for 10,000 cycles minimum.

- B. Cable Drums: Provide cast-aluminum or gray-iron casting cable drums grooved to receive cable. Mount counterbalance mechanism with manufacturer's standard ball-bearing brackets at each end of shaft. Provide 1 additional midpoint bracket for shafts up to 16 feet long and 2 additional brackets at one-third points to support shafts more than 16 feet long.
- C. Cable Safety Device: Include a spring-loaded, steel or bronze cam mounted to bottom door roller assembly on each side, designed to automatically stop door if either cable breaks.
- D. Bracket: Provide anchor support bracket, as required to connect stationary end of spring to the wall, to level shaft and prevent sag.
- E. Provide a spring bumper at each horizontal track to cushion door at end of opening operation.

2.05 ELECTRIC DOOR OPERATORS

- A. General: Provide electric door operator assembly of size and capacity recommended and provided by door manufacturer for door, complete with electric motor and factory-prewired motor controls, gear-reduction unit, control devices, and accessories required for proper operation.
- B. Disconnect Device: Provide hand-operated mechanism for automatically disengaging sprocket-chain operator from drive trolley. Provide plug-in chord for manual disconnect of motor.
- C. Provide control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24-V, ac or dc.
- D. Door-Operator Type: Provide unit consisting of electric motor and the following:
 - 1. Gear-head trolley type, with enclosed worm-gear running-in-oil primary drive, chain and sprocket secondary drive, and quick disconnect-release for manual operation.
 - 2. Jackshaft type, with V-belt primary reduction, chain intermediate reduction, roller chain drive connected to counterbalance shaft, and floor-level disconnect-release for manual operation.
- E. Electric Motors: Provide high-starting torque, reversible, continuous-duty, Class A insulated, electric motors, complying with NEMA MG 1, with overload protection, sized to start, accelerate, and operate door in either direction, from any position, at not less than 2/3 fps and not more than 1 fps, without exceeding nameplate ratings or considering service factor.
 - 1. Type: Single-phase, medium-induction type.
 - 2. Service Factor: According to NEMA MG 1, unless otherwise indicated.
 - 3. Coordinate wiring requirements with building electrical system.
- F. Remote-Control Station: Provide momentary-contact, 3-button control station with push-button controls labeled "Open," "Close," and "Stop."
- G. Obstruction Detection Device: Provide each motorized door with indicated external automatic safety sensor able to protect full width of door opening. Activation of sensor immediately stops and reverses downward door travel.
 - 1. Photoelectric Sensor: Manufacturer's standard system designed to detect an obstruction in door opening without contact between door and obstruction.
- H. Limit Switches: Provide adjustable switches, interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine wall and overhead areas, including opening framing and support framing, with Installer present, for compliance with requirements for installation tolerances, clearances, and other conditions affecting performance of Work of this Section.

3.02 INSTALLATION

- A. General: Install door, track, and operating equipment complete with necessary hardware, jamb and head mold strips, anchors, inserts, hangers, and equipment supports according to Shop Drawings, manufacturer's written instructions, and as specified.
- B. Fasten vertical track assembly to wall supports at not less than 24 inches o.c.

3.03 ADJUSTING

- A. Adjust doors as follows:
 - 1. Test and adjust controls. Replace damaged and malfunctioning controls and equipment.
 - 2. Align and adjust pulleys, cables and springs for smooth operation.

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SECTION 08 41 23

ALUMINUM-FRAMED ENTRANCES AND WINDOW WALLS

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes the following:
 - 1. Exterior aluminum-framed floor-to-floor window walls.
 - 2. Aluminum break-metal closure trim integral to window wall framing.
 - 3. Aluminum-framed entrance doors and hardware.
- B. Related Sections include the following:
 - 1. Section 07 92 00 "Joint Sealants" for installation of joint sealants installed with aluminum-framed window wall systems and for sealants to the extent not specified in this Section.
 - 2. Section 08 81 00 "Glass and Glazing" for glazing of glass within aluminum-framed window walls.

1.02 SYSTEM DESCRIPTION

- A. Design Requirements: Provide aluminum-framed systems of the appearance and profile intended, except as modified by performance requirements, as follows:
 - 1. Window wall framing system shall provide for flush-retained, captured, glazing on all perimeter sides and intermediate framing. Glass shall be off-set towards front of frame.
 - 2. System shall be either screw-spline, shear-block, compensating-stick system.
 - 3. Framing members design profile indicated on Drawings is: 2" wide x 6" deep.
 - 4. Finish: Class II, clear anodized.
- B. Performance Requirements: Provide aluminum-framed systems, including anchorage, capable of meeting, without failure, the effects of the following:
 - 1. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/min/sq. ft. of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 6.24 psf.
 - 2. 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 E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 8 psf. Leakage is defined according to AAMA 501.1, as no uncontrolled water penetrating framing systems normally exposed interior surfaces.
 - 3. Thermal Movements: Provide aluminum-framed systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperature differential of 180 degrees F.
 - 4. Design Wind Pressure: Required by Code for building height location, but not less than 20 psf.
 - 5. Structural Performance: Provide window wall systems when tested according to ASTM E 330 at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 1/175 of span.

1.03 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of product indicated. Include project specific warranty form.
- B. Samples for Finish Verification: For each type of exposed finish required.
- C. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.

1. For entrances, include hardware schedule and indicate operating hardware types, functions, quantities, and locations.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Capable of assuming engineering responsibility and performing work of this Section and who is acceptable to manufacturer.
- B. Entrances: Comply with NAAMM "Entrance Manual" for requirements for aluminum doors.
- C. Safety Glass: Category II materials complying with testing requirements in 16 CFR 1201 and ANSI Z97.1.
- D. Accessible Entrances: Comply with 2010 – "ADA Standards for Accessible Design".
- E. Field Measurements: Verify actual locations of structural supports for aluminum-framed systems 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 fabricating framing systems without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.05 WARRANTY

- A. Special Assembly 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 deteriorate as defined in this Section within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Deterioration of metals, metal finishes, gaskets and other materials beyond normal weathering.
 - c. Water leakage through fixed glazing and framing areas.
 - d. Failure of operating components to function properly.
 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Basis-of-Design Product: The design of aluminum-framed storefront systems are based on AFG601T manufactured by Arcadia Architectural Products, Inc. Subject to compliance with requirements, acceptable alternate manufacturers include one of the following:
 1. Kawneer Arconic Co.
 2. US Aluminum.

2.02 MATERIALS

- A. Aluminum Framing: Alloy and temper recommended by manufacturer for type of use and finish indicated:
 1. Extrusions: 6063 T6 aluminum alloy, ASTM B 221.
 2. Sheet: ASTM B 209, 0.032 thick, aluminum.
 3. Plate: ASTM B 209, 0.125 thick, aluminum.

2.03 FRAMING SYSTEMS

- A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.
- B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, fasteners and accessories compatible with adjacent materials complying with ASTM B 633.
- D. Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials. Form exposed flashing from sheet aluminum finished to match framing and of sufficient thickness to maintain a flat appearance without visible deflection.

2.04 GLAZING SYSTEMS

- A. Glazing Gaskets: Silicone compatible, compressible gaskets of molded santoprene complying with ASTM D 2000, or EPDM complying with ASTM C 864.
- B. Spacers and Setting Blocks: Manufacturer's standard elastomeric types.
- C. Weatherseal Sealant: ASTM C 920 for Type S, Grade NS, Class 25; neutral-curing silicone formulation compatible with glazing sealants and other system components. Sealant color: Black.

2.05 ALUMINUM-FRAMED DOORS

- A. Doors: Manufacturer's standard glazed doors, for manual swing operation.
 - 1. Door Construction: 1 1/2-inch overall thickness, with minimum 0.188-inch- thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deep penetration and fillet welded or that incorporate concealed tie rods.
 - 2. Door Design: Medium stile; 3-1/2-inch nominal width stiles.
 - a. Bottom Rail: Smooth surfaced for width of door in area within 10 inches above floor or ground plane.
 - 3. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.

2.06 ENTRANCE DOOR HARDWARE

- A. General: Provide heavy-duty performance rated hardware as recommended by entrance system and hardware manufacturers for entrances and uses indicated.
 - 1. Continuous Hinges: BHMA A156.26, Grade 1, continuous geared, clear anodized aluminum full-mortise hinge for 2-inch frames. Pemko CFM 108HD1 or equal.
 - 2. Locking Hardware: BHMA E8211, Grade 1. Adams-Rite MS1950 or equal.
 - 3. Cylinders and Trim: BHMA A156.5, Grade 1.
 - 4. Operating Trim: BHMA A156.6.
 - 5. Off-set Push/Pulls: BHMA A156.6, 1 1/4-inch dia., stainless steel finish, 18" CTC mounting, solid-rod off-set pull. Rockwood RM2510 SoftMet.
 - 6. Overhead Surface Closers: BHMA A156.4, Grade 1, hydraulic type with integral stop/hold-open and narrow-profile aluminum cover, mounted on interior side of framing.
 - 7. Door Stops: BHMA A156.16, Grade 1, floor or wall mounted, as appropriate for door location indicated, with integral rubber bumper.
 - 8. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.
 - 9. Aluminum Thresholds: Raised thresholds beveled with a slope of not more than 1:2, with maximum height of 1/2 inch. Mill finish.
 - 10. Silencers: BHMA A156.16, Grade 1.

2.07 ACCESSORY MATERIALS

- A. Joint Sealants: At perimeter of windowwall systems, as specified in Section 07 92 00 - "Joint Sealants."

2.08 FABRICATION

- A. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:
 - 1. Profiles are sharp, straight, and free of defects or deformations with accurately fitted joints with ends coped or mitered.
 - 2. Means to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
 - 3. Provisions for field replacement of glazing from exterior.
 - 4. Fasteners and connection devices that are concealed from view to greatest extent possible.
- B. Doors and Frames: Reinforce as required to support loads imposed by door operation and for installing hardware.

2.09 ALUMINUM FINISHES

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Class II, Clear Anodic Finish: AA-M12C22 A31 complying with AAMA 611.
 - 1. Finish: mechanical, nonspecular as fabricated; chemical: etched, medium matte.
 - 2. Anodic Coating: Class II, clear coating not less than 0.4 mils thick.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and rough-opening dimensions and other conditions affecting performance of work. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. General:
 - 1. Comply with manufacturer's written instructions and approved shop drawings.
 - 2. Securely anchor components in accordance with approved structural calculations.
 - 3. Fit joints to produce hairline joints free of burrs and distortion.
 - 4. Install anchors with separators and isolators to prevent metal corrosion.
 - 5. Seal joints watertight and to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
- B. Entrances: Install to produce smooth operation and tight fit at contact points.
 - 1. Field-Installed Hardware: Install surface-mounted hardware according to hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.
- C. Closure Trim: Install break-metal trim around steel columns, misc. steel framing and at corners to provide waterproof termination of framing systems and uniform appearance of installation.
- D. Sealants: Install perimeter joint sealants as specified in Section 07 92 00 "Joint Sealants" and to produce weathertight installation while maintaining internal drainage of framing system to exterior.
 - 1. Joint Width: 1/2 inch, plus or minus 1/8 inch.
- E. Erection Tolerances: Install aluminum-framed systems to comply with the following tolerances:
 - 1. Location and Plane: Limit variation to 1/8 inch in 12 feet, 1/4 inch over total length.

2. Alignment: Where surfaces abut in line, limit offset from true alignment to 1/16 inch.
3. Diagonal Measurements: Limit difference between diagonal measurement to 1/8 inch.
4. Perimeter Sealant Joint Width: Verify that rough openings and fabrication of framing systems will ensure perimeter sealant joint widths do not exceed 3/4 inch or are less than 3/8 inch in width.

3.03 GLAZING

- A. Refer to Section 08 81 00 for installation of glass and glazing components.

3.04 FIELD QUALITY CONTROL

- A. Field Water Spray Test: Before installation of interior finishes has begun, a minimum area of 120 sq. feet of aluminum-framed systems at locations designated by Architect shall be field tested according to AAMA 501.2 and shall not evidence water penetration.
- B. Repair or remove work where test results and inspections indicate that it does not comply with specified requirements. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.05 ADJUSTING

- A. Door Entrances: Adjust operating hardware for smooth operation according to hardware manufacturers' written instructions.

3.06 PROTECTION AND CLEANING

- A. Protect framing from damage immediately after installation. Do not apply markers to aluminum surfaces. Remove nonpermanent labels, and clean surfaces.

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SECTION 08 62 13

UNIT SKYLIGHTS

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes factory-assembled fixed unit skylights for installation in flat roof areas.
 - 1. Type: Double-glazed, self-flashing integral-curb units.
- B. Related Sections include the following:
 - 1. Section 07 54 23 - "TPO Membrane Roofing" for integration of roof membrane at unit skylights.

1.02 REFERENCES

- A. National Fenestration Rating Council (NFRC).
 - 1. 100 - Procedure for Determining Fenestration Product U-Factors.
 - 2. 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance of Normal Incidence.
- B. International Code Council (ICC).
 - 1. 2021 International Building Code (IBC).
 - 2. 2021 International Energy Conservation Code (IECC).

1.03 SUBMITTALS

- A. Product Data: For unit skylights. Include construction details, material descriptions, dimensions of individual components and profiles, finishes and attachments to other Work.

1.04 QUALITY ASSURANCE

- A. Code Conformance: Provide ICC-ES listing for skylight units listed as approved by municipality of jurisdiction and meeting requirements of IBC Section 2405 and IECC Section C402.
- B. Fall-Protection: Where plastic glazing is not sufficient to withstand a human impact load of 400 lbs., provide security bar grills or screens in accordance with O.S.H.A. Regulations 29 CFR 1910.29(e)(1).

1.05 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of unit skylights that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, the following:
 - 1. Uncontrolled water leakage.
 - 2. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 3. Thermal breakage of polycarbonate glazing.
- B. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Unit Skylights: Basis-of-Design product is based on Sunweld unit skylights by Carlisle Syntec.
 - 1. Model: 4896-SF-2-P-TB-MF-WTL
- B. Subject to compliance with requirements, acceptable manufacturers offering products that may be incorporated into the Work include the following:
 - 1. Skyco Skylights 4896-SF-A-SPIR-MF; Kingspan ESR-3837
 - 2. Model 297; Plasteco.
 - 3. Bristolite Coolight 4896-ALI-SF9-2-MF-WTL; Kingspan Light+Air LLC ESR-3177

2.02 UNIT SKYLIGHTS

- A. General: Factory-assembled, integral-curb, deck-mounted units that include glazing, glazing retainers, gaskets, and inner frames and that are capable of withstanding design loads indicated.
 - 1. Height: 9 inches.
 - 2. Deck Flange Width: 2 inches minimum.
 - 3. Curb Insulation: Manufacturer's standard rigid or semi-rigid type, 1 1/2" thick.
 - 4. Frame Finish: Standard mill finish.
- B. Unit Shape and Size: Rectangular, 46-by-90-inch minimum inside curb.
- C. Dome Glazing: ASTM D 4802, thermoformed, monolithic sheet acrylic-plastic or polycarbonate sheets as standard with manufacturer.
 - 1. Double-Glazing Profile: Double-dome, insulated-glazing type.
 - a. Outboard Glazing: Translucent prismatic-dome with Low-E energy reduction coating.
 - b. Inboard Glazing: Clear prismatic acrylic.
 - c. Maximum Solar Heat Gain Coefficient (SHGC): 0.40.
 - d. Maximum Thermal U-value: 0.70.
- D. Aluminum Frame Components:
 - 1. Sheets: ASTM B 209, 0.40" thick aluminum alloy and temper to suit forming operations and finish requirements but with not less than the strength and durability of alclad alloy 3005-H25.
 - 2. Extruded Shapes: ASTM B 221, alloy and temper to suit structural and finish requirements but with not less than the strength and durability of alloy 6063-T52.
 - 3. Construction: Mitered frame with full-penetration welded corners of curb and retaining frames.
 - a. Frame Cap: One-piece welded frame, designed to allow drainage over roof counter-flashing.
- E. Security Grilles: Painted, 1/2-inch diameter, hardened steel bars spaced not more than 6 inches o.c. in each direction, welded into a one-piece mat and perimeter frame.

2.03 INSTALLATION MATERIALS

- A. Elastomeric Sealant: ASTM C 920; Type S; Grade NS; as recommended by unit skylight manufacturer.
- B. Deck Fasteners: Noncorrosive steel as recommended by unit skylight manufacturer.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Coordinate unit skylight installation with installation of substrates, roof insulation, roofing, and flashing as required to ensure that each element performs properly and are waterproof and weathertight.
 - 1. Unless otherwise indicated, install unit skylights according to construction details of NRCA's "The NRCA Roofing and Waterproofing Manual."

- B. Anchor unit skylights securely to supporting roof deck framing to withstand 30 psf up-lift pressure.
- C. Set unit skylight flanges in bed of approved roofing sealant to form a seal, unless otherwise indicated.
- D. Install curb counter-flashing to produce waterproof overlap with roofing and skylight cap flashing.

3.02 CLEANING

- A. Clean exposed surfaces according to manufacturer's written instructions. Touch up damaged metal coatings.

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SECTION 08 71 00

DOOR HARDWARE

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes: Hardware and related items for interior and exterior doors, other than specified in other Sections.
 - 1. Commercial door hardware for swinging doors.
 - 2. Cylinders for aluminum doors specified in other Sections.
 - 3. Fire Department lock boxes.

1.02 SYSTEM DESCRIPTION

- A. Door Hardware: Furnish hardware components that are new, free of defects or damage, of proper design for use in doors and frames of the thicknesses, profile, performance grade and similar requirements indicated, complete with accessories as necessary for proper installation and function.
 - 1. Hardware components shall be coordinated by an Architectural Hardware Consultant, certified by DHI, for proper installation and function with doors, frames, and related work to ensure proper size, hand, finish and assembly of all door hardware components regardless of omissions or conflicts with information in the Contract Documents.

1.03 SUBMITTALS

- A. Door Hardware Sets: Submit schedules and product data of each type of hardware required for Project, in accordance with Section 01 10 00. Submit copies in DHI format, indicating manufacturer, type, style, function, size, quantity, and finish of each door hardware set. Include description and function of each lockset and exit device.
 - 1. Use same reference designations indicated on floor plans and in door schedule.
 - 2. Description of each electrified door hardware function, including location, sequence of operation, and interface with other building control systems, power, signal, and control wiring.
 - 3. Keying: Provide construction cores that are replaceable by permanent cores without cylinder removal.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Personnel trained and approved by lock manufacturer.
 - 1. Installer's responsibilities include supplying and installing door hardware and providing a qualified Architectural Hardware Consultant available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.
 - 2. Installer shall have warehoused inventory in Project's vicinity.
- B. Regulatory Requirements:
 - 1. Comply with the following:
 - a. 2010 ADA "Standards for Accessible Design" and ADAAG.
 - b. 2021 International Building Code, Chapter 11.
 - 2. Any item furnished or installed that does not meet code requirements shall be removed and proper items substituted at no additional cost or expense to the Owner.
 - 3. Provide hardware which has been tested and listed by U.L. for the types and sizes of doors required, and which complies with the requirements of the doors and frame labels.

- C. Standards: Comply with the following:
 1. ANSI/BHMA A156, Door Hardware Standards.
 2. DHI, Door Hardware Institute.
 3. NFPA 80, Fire Doors and Windows.
 4. NFPA 101, Life-Safety Code, for egress doors.
 5. NFPA 70, National Electric Code.
 6. UL Standard 305 - Panic Hardware.
- D. Fire-Rated Openings: Provide hardware for fire-rated openings in compliance with NFPA Standard No. 80 and No. 101, 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.
 1. Where panic exit devices are required on fire-rated doors, provide supplementary marking on door U.L. Label indicating "Fire Exit Hardware".

1.05 COORDINATION

- A. Templates: Distribute door hardware templates for doors, frames, and other work specified to be factory prepared for installing door hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

1.06 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Faulty operation of operators and door hardware.
 - b. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
 2. Warranty Period: 2 years from date of Substantial Completion, except as follows:
 - a. Closers: 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers listed establish the basis of design for each hardware item. Equivalent products may be substituted by the listed approved manufacturers where equal in quality and function.

<u>Hardware Item:</u>	<u>Manufacturer:</u>	<u>Approved Equal</u>	<u>Approved Equal</u>
1. Butt Hinges:	Ives	McKinney	Stanley
2. Locksets:	Schlage	Yale	Sargent
3. Exit Devices:	Adams Rite	Yale	Von Duprin
4. Closers:	LCN	Yale	Norton
5. Wall/Floor Stops:	Ives	Trimco	Rockwood
6. Seals/Sweeps:	Pemko	National Guard	Reese
7. Thresholds:	Pemko	National Guard	Reese
8. Operating Trim:	Ives	Rockwood	Hiawatha

2.02 DOOR HARDWARE

- A. General: Provide door hardware for each door to comply with requirements in this Section and Door Hardware Sets indicated on Drawings or scheduled at the end of this Section.

2.03 HINGES

- A. General: BHMA A156.1, five-knuckle, steel or stainless steel material, fabricated to template with flat button tips, non-rising loose steel pins, and beveled or non-beveled inner edge.
 - 1. Pins: Non-removable for exterior out-swinging doors.
 - 2. Quantity per Door Leaf: Provide the following, unless otherwise indicated:
 - a. Three Hinges: For doors less than 94 inches in height.
 - b. Four Hinges: For doors 95 inches or more in height.
 - 3. Hinge Size: 4-1/2 inches x 4-1/2 inches, square corners, of sufficient width to clear trim.
 - 4. Hinge Weight: Unless otherwise indicated, provide the following:
 - a. Type 1 (Interior Doors): Plain bearing, steel, standard-weight hinges.
 - b. Type 2 (Doors with Closers): Antifriction ball-bearing steel, standard-weight hinges.
 - c. Type 3 (Exterior Doors): Heavy-weight, ball-bearing stainless steel hinges.
 - 5. Template Dimension Requirements: BHMA A156.7.
- B. Manufacturer: Ives; hinge types:
 - 1. Type 1: 5PB1
 - 2. Type 2: 5BB1
 - 3. Type 3: 5BB1HW
- C. Pivots and Pivot Hinges:
 - 1. Pivots: BHMA A156.4.

2.04 LOCKS AND LATCHES

- A. General Requirements: Lock function and descriptions indicated in door hardware sets to comply with the following:
 - 1. Latches and Locks for Means of Egress Doors: Comply with NFPA 101. Latches shall not require more than 15 lbf to release the latch. Locks shall not require use of a key, tool, or special knowledge for operation.
 - 2. Backset: 2-3/4 inches, unless otherwise indicated.
- B. Mechanical Bored Cylinder Locks: BHMA A156.2, Grade 1; Series 4000, with interchangeable cores.
 - 1. Manufacturer: Schlage; ND Series, RHO lever trim.

2.05 EXIT DEVICES

- A. Exit Devices: BHMA A156.3, Grade 1.
 - 1. Product: Von Duprin; Series 98NL.
- B. Panic Fire Exit Devices: Devices complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire and panic protection, based on testing according to UL 305 and NFPA 252.
 - 1. Outside Trim: Lever with cylinder, material, finish to match locksets and latchsets.

2.06 LOCK CYLINDERS

- A. Cylinders: BHMA A156.5, Grade 1A, listed and labeled as complying with requirements in UL 437. Manufacturer's standard tumbler type, constructed from brass or bronze and complying with the following:
 - 1. Number of Pins: Seven-pin interchangeable cores.
 - 2. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
 - 3. Bored-Lock Type: Cylinders with tailpieces to suit locks.
- B. Permanent Cores: Manufacturer's standard; finish face to match lockset; complying with the following:
 - 1. Removable Cores: Core insert, removable by use of a special key; for use with specified manufacturer's cylinder.
- C. Keying: Comply with the following:

1. Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide 10 construction master keys.
2. Construction Cores: Provide construction cores that are replaceable by permanent cores.
 - a. Furnish permanent cores to Owner for installation at project close-out.

2.07 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; with forged-steel main arm; enclosed in full cover; complying with the following:
 1. Type: Regular parallel folding arm.
 2. Back-check: Adjustable, effective between 60 and 85 degrees of door opening.
 3. Cover Material: Aluminum.
 4. Provide type of arm and adapter shoes required for closer to be located on hinge side of door.
 5. Manufacturer: LCN 4041.
- B. Accessibility Requirements: Comply with the following maximum opening-force requirements:
 1. Interior, Non-Fire-Rated Hinged Doors: 5 lbf applied perpendicular to door.
 2. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.

2.08 STOPS AND HOLDERS

- A. Stops and Bumpers: BHMA A156.16, Grade 1.
 1. Provide floor stops for doors unless wall or other type stops are scheduled or indicated. Locate wall bumpers to prevent lockset lever or closer from touching wall. Walls to receive proper backing for wall bumpers.
- B. Manufacturer: Ives; door stops:
 1. Wall Stop: WS401CVX
 2. Floor Stop: FS436
- C. Silencers for Metal Door Frames: BHMA A156.16, Grade 1; neoprene or rubber, minimum diameter 1/2 inch; fabricated for drilled-in application to frame; 3 at each jamb of single doors, 2 at each jamb of double doors. Not required on doors having weatherstrip or seals.

2.09 DOOR GASKETING

- A. Weatherstrip Gaskets: Compressible, teardrop shape vinyl with adhesive strip. Apply to head and jamb, forming seal between door and frame.
- B. Door Bottom Sweeps: Clear anodized aluminum trim with neoprene or silicone rubber inserts. Apply to bottom of door, forming seal with threshold when door is closed. Provide only those units where seal strips are easily replaceable and readily available from manufacturer.
- C. Manufacturer: Pemko:
 1. Sweeps: 3151CN
 2. Weatherstrip: S88GR

2.10 THRESHOLDS

- A. Thresholds: BHMA A156.21, mill finish aluminum, beveled raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch high.
- B. Manufacturer: Pemko:
 1. 5" Saddle: 271
 2. 4" Half-saddle: 274
 3. 5" Gasketed: 2005V

2.11 OPERATING TRIM

- A. Push/Pulls and Plates: BHMA A156.6, 630 finish unless otherwise scheduled.

2.12 MISCELLANEOUS HARDWARE

- A. Lock Box: Knox Co., black powder coat finish, mounted 66-inches above grade.
 - 1. Building Entry: Model 3270, Recess-mounted, 4"W x 5"H x 3-1/4" deep with 7"W x 7"H flange, Provide at two locations.
 - 2. Riser Door: Model 1658, Surface-mounted, 4"W x 5"H x 2-3/4" deep. Provide at each riser location.
 - 3. Gate key-switch knox-box provided by gate contractor.
- B. Rain Drip Caps: Aluminum, single length over full width of door frame head. Reese R199A or equal.
- C. Door Viewer: Ives; 698, 626 finish or equal. Mount 60 inches above floor, centered horizontally in door.

2.13 FINISHES

- A. Finishes: BHMA 156.18, as follows, unless scheduled otherwise:
 - 1. Exterior Hinges: BHMA 630 (US32D) satin stainless steel.
 - 2. Interior Hinges: BHMA 652 (US26D) satin chromium plated steel.
 - 3. Locksets: BHMA 626 (US26D) satin chromium plated brass.
 - 4. Push Plates & Pulls: BHMA 630 (US32D) satin stainless steel.
 - 5. Closers: BHMA 689 (US28) aluminum painted.
 - 6. Wall and Floor Stops: BHMA 626 (US26D) satin chromium plated brass.
 - 7. Sweeps: BHMA 628 (US28) anodized satin aluminum.
 - 8. Thresholds: mill aluminum.
 - 9. Gaskets and Silencers: Grey.

PART 3 - EXECUTION

3.01 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. Examine rough-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

3.02 PREPARATION

- A. Steel Doors and Frames: Comply with DHI A115 Series.
 - 1. Surface-Applied Door Hardware: Drill and tap doors and frames according to SDI 107.

3.03 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights indicated as follows unless otherwise indicated or required to comply with governing regulations.
 - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
- 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, and reinstallation of surface trim with finishing work. 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. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Section 07 92 00 "Joint Sealants."

3.04 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. Door Closers: Adjust sweep period so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the edge of the door.

3.05 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.

3.06 HARDWARE SCHEDULE

- A. See Drawings for schedule of hardware types.

END OF SECTION

SECTION 08 81 00

GLASS AND GLAZING

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes glazing, including those specified in other Sections where glazing requirements are specified by reference to this Section:
 - 1. Glazed storefronts.
 - 2. Glazed window walls.
 - 3. Glazed entrances.
- B. Related Sections include the following:
 - 1. Section 08 41 23 for "Aluminum-Framed Entrances and Window Walls" for glazing of glass within aluminum-framed glazing components.
 - 2. Section 07 92 00 for "Joint Sealants" for installation of joint sealants installed with aluminum-framed systems and for sealants to the extent not specified in this Section.

1.02 DEFINITIONS

- A. Manufacturers of Glass Products: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Deterioration of Coated Glass: Defects developing from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking and other indications of deterioration in metallic coating.
- C. Deterioration of Insulating Glass: Failure of hermetic seal under normal use that is attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by particles, moisture, or film on interior surfaces of glass.
- D. Deterioration of Laminated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delaminating material obstructing vision through glass and blemishes exceeding those allowed by referenced laminated glass standards.

1.03 PERFORMANCE REQUIREMENTS

- A. Glass Design: Glass thickness designations indicated are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites in the thickness designations indicated for various size openings, but not less than thicknesses and in strengths (annealed or heat treated) required to meet or exceed the following criteria:
 - 1. Glass Thicknesses: Select minimum glass thicknesses to comply with ASTM E 1300, according to the following requirements:
 - a. Design Wind Loads: Determine design wind loads applicable to Project from basic wind speed indicated in miles per hour 33 feet above grade, according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures".
- B. Thermal and Optical Performance Properties: Provide glass with performance properties specified based on manufacturer's published test data, as determined according to procedures indicated below:

1. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
 - a. Center of glass U-Value: NFRC 100 methodology using LBNL WINDOW 5.2/6.3 computer program.
 - b. Center of glass solar heat gain coefficient: NFRC 200 methodology using LBNL-35298 WINDOW 5.2/6.3 computer program.
 - c. Solar optical properties: NFRC 300.

1.04 SUBMITTALS

- A. Samples: Submit three, 12-inch x 12-inch samples of each type and color of glass indicated.
- B. Product Data and Test Reports: For each of the following types of glazing products:
 1. Insulating glass.
 2. Glazing sealants.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in glass installations with a record of successful in-service performance; and who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.
- B. Source Limitations for Glass: Obtain all glass products through one source from a single manufacturer for each glass type.
- C. Source Limitations for Glazing Accessories: Obtain glazing accessories through one source from a single manufacturer for each product and installation method indicated.
- D. Glass Product Testing: Obtain glass test results for product test reports in "Submittals" Article from a qualified testing agency based on testing glass products.
 1. Glass Testing Agency Qualifications: An independent testing agency accredited according to the NFRC Certification Program.
- E. Elastomeric Glazing Sealant Product Testing: Obtain sealant test results for product test reports in "Submittals" Article from a qualified testing agency based on testing current sealant formulations within a 36-month period.
- F. Safety Glazing Products: Comply with testing requirements in 16 CFR 1201.
 1. Subject to compliance with requirements, obtain safety glazing products permanently marked with certification label of the Safety Glazing Certification Council or another certification agency acceptable to authorities having jurisdiction.
 2. Where glazing units, including Kind FT glass, are specified in PART 2 articles, provide glazing products that comply with Category I or II materials.
- G. Codes and Standards: Comply with applicable provisions of the following codes, specifications and standards, unless more stringent provisions are indicated or specified:
 1. 2021 International Building Code
 2. ASTM C 1036 Standard Specification for Flat Glass
 3. ASTM C 1048 Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass
 4. ASTM C 1172 Standard Specification for Laminated Architectural Flat Glass
 5. ASTM C 1376 Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass
 6. ASTM E 2190 Standard Specification for Insulating Glass Unit Performance and Evaluation
 7. ASTM E 1300 Standard Practice for Determining Load Resistance of Glass in Buildings
 8. NFRC 100/200 National Fenestration Rating Council certification program for glass thermal and optical properties
 9. ANSI Z97.1 Performance Specifications and Methods of Test for Safety Glazing Materials Used in Buildings
 10. CPSC 16 CFR 1201 Safety Standard for Architectural Glazing Materials

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions to prevent damage to glass and glazing materials from condensation, direct exposure to sun, or other causes.

1.07 PROJECT CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
 - 1. Do not install liquid glazing sealants when ambient and substrate temperature conditions are outside limits permitted by glazing sealant manufacturer or below 40 deg F.

1.08 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form, made out to Owner and signed by coated-glass manufacturer agreeing to replace coated-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
 - 1. Warranty Period: 10 years from date of Substantial Completion.
- B. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form, made out to Owner and signed by insulating-glass manufacturer agreeing to replace insulating-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PRODUCTS AND MANUFACTURERS

- A. Vision Glass Manufacturer: Subject to compliance with requirements, provide glass products equal to:
 - 1. Vision-Lite Insulating Units: SNX 51/23 CrystalGray, by Guardian SunGuard.
 - 2. Overall Unit Thickness and Thickness of Each Lite: 25 mm and 6 mm.
 - 3. Interspace Content: Air.
 - 4. Exterior Lite: Class 1 (clear) float glass.
 - 5. Indoor Lite: Class 1 (clear) float glass.
 - 6. Low-E Coating: Second surface.
 - 7. Visible Light Transmittance: 36 percent.
 - 8. Summer U-Factor: 0.27 maximum.
 - 9. Solar Heat Gain Coefficient: 0.20.
 - 10. Shading Coefficient: 0.22.
 - 11. Outdoor Visible Reflectance: 9 percent.
- B. Insulating Coated Spandrel Glass Manufacturer: Subject to compliance with requirements, provide glass products equal to:
 - 1. Spandrel-Lite Insulating Units: same as vision lites.
 - 2. Overall Unit Thickness and Thickness of Each Lite: 13 mm and 6 mm.
 - 3. Exterior Lite: Heat-Strengthened, Class 1 (clear) float glass.
 - 4. Indoor Lite: Heat-Strengthened, Class 1 (clear) float glass.
 - 5. Low-E Coating: Second surface.
 - 6. Spandrel Coating: Fourth surface, Deco HT – Warm Grey

2.02 PRIMARY FLOAT GLASS

- A. Float Glass: ASTM C 1036, flat glass, Type 1, Class 1 (clear) or Class 2 (tinted, heat-absorbing) and Quality q3; 1/4 thick minimum.

2.03 HEAT-TREATED FLOAT GLASS

- A. Heat-Treated Float Glass: ASTM C 1048 (annealed) or ASTM C 1036 (heat-strengthened); flat glass, Type 1, Class 1 (clear) or Class 2 (tinted) and Quality q3; 1/4 thick minimum. Fabricate by horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed.
 - 1. Provide Kind HS (heat-strengthened) float glass in place of annealed glass where needed to resist thermal stresses induced by differential shading of individual glass lites.
 - 2. Provide Kind FT (fully tempered) complying with ANSI Z97.1 and CPSC 16 CFR 1201, where safety glass is required.
 - 3. Fabrication Tolerances:
 - a. Maximum Peak-to-Valley Rollerwave: 0.008".
 - b. Maximum bow and warp: 1/32" per lineal foot.

2.04 COATED FLOAT GLASS

- A. Coated Float Glass: Heat-treated float glass complying with ASTM C 1376 for magnetically sputtered vacuum deposition coatings, and with requirements specified.
 - 1. Provide Kind HS (heat-strengthened) coated float glass in place of coated annealed glass where needed to resist thermal stresses induced by differential shading of individual glass lites.
 - 2. Provide Kind FT (fully tempered) complying with ANSI Z97.1 and CPSC 16 CFR 1201, where safety glass is required.

2.05 SEALED INSULATING GLASS

- A. Insulating-Glass Units: Preamsembled units consisting of sealed lites of glass separated by a dehydrated interspace, and complying with ASTM E 774 for Class CBA units and with requirements specified in this Article.
 - 1. Provide Kind HS (heat-strengthened) float glass in place of annealed glass where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with glass design requirements specified in "Performance Requirements" Article. Provide Kind FT (fully tempered) where safety glass is indicated.
- B. Edge Sealing System: Dual seal, with primary and secondary silicone sealants.
- C. Insulating-Glass Units, General: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, and complying with ASTM E 774 for Class CBA units and with requirements specified in this Article.
 - 1. Provide Kind FT (fully tempered) glass lites where safety glass is indicated or required.
 - 2. Overall Unit Thickness and Thickness of Each Lite: Dimensions indicated for insulating-glass units are nominal and the overall thicknesses of units are measured perpendicularly from outer surfaces of glass lites at unit's edge.
 - 3. Sealing System: Dual seal, with primary and secondary sealants as follows:
 - a. Manufacturer's standard sealants.
 - 4. Spacer Specifications: Manufacturer's standard spacer material and construction.

2.06 ELASTOMERIC GLAZING SEALANTS

- A. General: Provide products of type indicated, complying with the following requirements:
 - 1. Compatibility: Select glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application.
 - 2. Colors of Exposed Glazing Sealants in contact with glass: Black
- B. Elastomeric Glazing Sealant Standard: Comply with ASTM C 920, Type S, Grade NS, Use G.

2.07 GLAZING TAPES

- A. Mastic Glazing Tape: Preformed, butyl-based elastomeric tape with a solids content of 10 percent; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended by tape and glass manufacturers for application indicated.

2.08 GLAZING GASKETS

- A. Compression Gaskets: Molded or extruded gaskets as specified in Section 08410.

2.09 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks and Spacers: Elastomeric with a Shore A durometer hardness of 85, plus or minus 5.

2.10 FABRICATION OF GLASS AND OTHER GLAZING PRODUCTS

- A. Fabricate glass and other glazing products in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing standard, to comply with system performance requirements.
- B. Grind smooth and polish exposed glass edges.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine framing glazing, with Installer present, for compliance with the following:
 - 1. Manufacturing and installation tolerances, including those for size and squareness at corners.
 - 2. Presence and functioning of drainage system.
 - 3. Minimum required face or edge-bite clearances.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 TAPE GLAZING

- A. Position tapes and apply sealants in manner complying with aluminum-framing manufacturer's requirements to maintain a water-tight and self-draining window wall assembly.

3.03 GASKET GLAZING (DRY)

- A. Install compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, and allow for thermal movement. Compress gaskets to produce a weathertight seal without developing bending stresses in glass.

3.04 PROTECTION AND CLEANING

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove them immediately as recommended by glass manufacturer.
- C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for build-up of dirt, scum, alkaline deposits, or stains; remove as recommended by glass manufacturer.
- D. Remove and replace glass that is broken, chipped, cracked, abraded, or damaged in any way, including natural causes, accidents, and vandalism, during construction period.
- E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended by glass manufacturer.

END OF SECTION

SECTION 09 29 00

GYPSUM BOARD

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes the following:
 - 1. Interior gypsum board, Level 4 finish at walls.
- B. Related Sections include the following:
 - 1. Section 07 21 16 for "Building Insulation" for insulation in gypsum board assemblies.

1.02 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.03 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: For gypsum board assemblies with fire-resistance ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency acceptable to authorities having jurisdiction.
 - 1. Fire-Resistance-Rated Assemblies: Indicated by design designations from UL's "Fire Resistance Directory."
- B. Sound Transmission Characteristics: For gypsum board assemblies with STC ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by a qualified independent testing agency.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials bearing brand name and identification of manufacturer or supplier.
- B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Stack gypsum panels flat to prevent sagging.

1.05 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

PART 2 - PRODUCTS

2.01 GYPSUM WALLBOARD

- A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.

- B. Gypsum Wallboard: ASTM C 36.
 - 1. Regular Type:
 - a. Thickness: 5/8 inch, unless otherwise indicated .
 - b. Long Edges: Tapered for prefilling.
 - 2. Type X:
 - a. Thickness: 5/8 inch.
 - b. Long Edges: Tapered for prefilling.

2.02 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
 - 1. Material: Hot-dip galvanized steel sheet or rolled zinc.
 - 2. Shapes:
 - a. Cornerbead: Use at outside corners.
 - b. LC-Bead: J-shaped; exposed long flange receives joint compound; use at exposed panel edges.

2.03 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475.
- B. Joint Tape:
 - 1. Interior Gypsum Wallboard: Paper.
 - 2. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for 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 and damaged surface areas, use setting-type taping compound.
 - 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, trim flanges, and paper-faced metal trim accessories, use setting-type taping compound.
 - 3. Fill Coat: For second coat, use setting-type, sandable topping compound.
 - 4. Finish Coat: For third coat, use drying-type, all-purpose compound.

2.04 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
 - 1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
 - 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- C. Sound Attenuation Blankets: ASTM C 665, 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.
- D. Thermal Insulation: As specified in Division 7 Section "Building Insulation."

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 APPLYING AND FINISHING PANELS, GENERAL

- A. Gypsum Board Application and Finishing Standards: ASTM C 840 and GA-216.
- B. 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.
- C. Attach gypsum panels to steel studs so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- D. Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's written recommendations.
 - 1. Space screws a maximum of 12 inches o.c. for vertical applications.
 - 2. Space fasteners in panels that are tile substrates a maximum of 8 inches o.c.

3.03 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 instructions.

3.04 FINISHING GYPSUM BOARD ASSEMBLIES

- 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, beveled edges, and damaged surface areas.
- C. Apply joint tape over board joints, except those with trim having flanges not intended for tape embedment.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below, according to ASTM C 840, for locations indicated:
 - 1. Level 4: All joints and interior angles shall have tape embedded in joint compound and two separate coats of joint compound applied over all flat joints and one separate coat of joint compound applied over interior angles. Fastener heads and accessories shall be covered with three separate coats of joint compounds. All joint compound shall be smooth and free of tool marks and ridges.

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SECTION 09 91 16

PAINTING

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes surface preparation and field painting of exterior items and surfaces and interior painting, including the following:
 - 1. Site-cast tilt-panel concrete.
 - 2. Site masonry walls.
 - 3. Back-side of roof parapets.
 - 4. Exterior gypsum board soffits.
 - 5. Interior steel columns.
 - 6. Hollow metal doors and frames.
 - 7. Access doors and frames.
 - 8. Misc. steel for bollards, gates, rough hardware and similar exterior items.
 - 9. Electrical panels and service entrance equipment, wall-mounted landscape controllers, water piping, back-flow device piping, equipment covers and similar above-grade utility items.
- B. Related Sections include the following:
 - 1. Section 03 30 00 for "Cast-in-Place Concrete" for concrete floor sealer application.
 - 2. Section 05 12 00 for "Structural Steel" for shop priming structural steel.
 - 3. Section 05 31 13 for "Steel Decking" for shop priming of metal decking.
 - 4. Section 05 50 00 for "Metal Fabrications" for shop priming and field painting of ferrous metals.
 - 5. Section 05 51 10 for "Steel Stairs" for shop priming and field painting metal stair components.
 - 6. Section 32 17 23 for "Traffic Marking Paint" for traffic-marking paint in paved areas.
- C. Paint exposed surfaces, except where a surface or material is specifically indicated not to be painted or is to remain a natural finish. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces. If a color or gloss is not indicated, request clarification from Architect, prior to painting.
 - 1. Interior painting includes field painting of:
 - a. Drywall partitions and ceilings;
 - b. Exposed pipes, miscellaneous steel supports and embeds;
 - c. Surfaces of mechanical and electrical equipment that do not have a factory-applied final finish coat;
 - d. Exposed metal deck and steel supports, only to the extent where specifically indicated on the Drawings.
- D. Painting is not required on factory-prefinished interior items, surfaces concealed from view, finished metal surfaces, operating parts, and labels. Prime coats are not considered prefinished coats.
 - 1. Prefinished items include the following:
 - a. Architectural millwork, casework and paneling.
 - b. Acoustical ceiling tile or wall panels.
 - c. Mechanical system components, including air-diffusers and grills.
 - d. Interior electrical equipment, panels, light fixtures.
 - e. Anodized, powder-coated or PVDF coated metal.
 - f. Polished, plated or stainless steel surfaces.
 - 2. Labels: Do not paint over UL, or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

1.02 DEFINITIONS

- A. Gloss and Sheen: Standard coating terms defined in ASTM D 523 apply to this Section.

1. Flat: matte finish with a maximum gloss below 5 units.
2. Low Sheen: low-sheen finish with a maximum gloss below 10 units.
3. Eggshell: low-sheen finish with a gloss range between 10 and 25 units.
4. Satin: medium-sheen finish with a gloss range between 20 and 35 units.
5. Semi-gloss: medium-sheen finish with a gloss range between 35 and 70 units.
6. Gloss: high-sheen finish with a gloss range between 70 and 85 units.

1.03 SUBMITTALS

- A. Product Data: For each paint system indicated. Include block fillers and primers.
 1. Material List: Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
 2. VOC Content: For all products or components applied to the interior of the building. Include certifications of VOC compliance with local regulatory agencies, where applicable.
- B. Samples for Verification Purposes: Provide draw-down samples for each color, sheen and material to be applied, with texture to simulate actual conditions of substrates.

1.04 QUALITY ASSURANCE

- A. Applicator Qualifications: A firm or individuals experienced in applying paints and coatings 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.
- B. Standards: Preparation, application and workmanship shall be in accordance with manufacturer's recommendations and applicable provisions of the following:
 1. Painting and Decorating Contractors of America (PDCA) "Painting Specification Manual" and "Standards".
 2. Gypsum Association - GA210, "Gypsum Board for Walls and Ceilings."
- C. Source Limitations: Obtain thinners, fillers and primers from the same manufacturer as the finish coats.
- D. Exterior Color Mock-up: After approval of draw-down samples, provide a 20' x 20' test area on area designated by the Architect, of the approved colors at locations indicated on the Drawings. Contractor shall include the cost of color mock-up in the base bid, including the cost to repaint mock-up one additional time.
 1. Approval of mockups is for color, texture, and blending of coatings; include cost to apply a second alternative color application, should initial colors not be approved.
 2. Do not order paint materials until mock-ups have been approved.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name, product label and date of manufacturer.
- B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 50 deg F. Maintain storage containers in a clean condition, free of foreign materials and dried residue. Protect from freezing. Remove oily rags and combustible waste daily.

1.06 PROJECT CONDITIONS

- A. Environmental Requirements: Apply paints only when surfaces are dry and temperatures of surfaces to be painted and surrounding air are between 50 and 100 deg F.

1. Do not apply exterior paint in damp or rainy weather or until after the surface has dried thoroughly from the effects of such weather.
2. Provide adequate ventilation for interior painting so humidity levels do not rise above the dew point of the surface to be painted.
3. Moisture-containing surfaces, such as concrete, stucco and cement plaster shall have a moisture content of less than 8 percent as measured by moisture meter. Remove surface salt deposits prior to painting. Verify that pH is within acceptable limits of Paint Manufacturer.

1.07 EXTRA MATERIALS

- A. Furnish extra paint materials, packaged with identifying labels describing contents, and deliver to Owner.
 1. Quantity: Furnish Owner with extra paint materials of 5 gal. of each color and gloss.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 1. Dunn-Edwards (DE)
 2. PPG Architectural Coatings (PPG)
 3. Sherwin-Williams Co. (SW)

2.02 PAINT MATERIALS, GENERAL

- A. Material Compatibility: Provide block fillers, primers, and finish-coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
- B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Materials selected for coating systems for each type of surface shall be the products of a single manufacturer. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
- C. Regulation Compliance: Materials used shall comply with applicable Federal and local air pollution regulations, lead content laws, and current VOC requirements. If products listed herein are not in compliance with regulations, laws, or requirements, Contractor shall notify Architect and shall provide information regarding substitute products that are in compliance with current VOC requirements.
- D. Supplementary materials such as thinners, linseed oil, shellac, turpentine, driers, and other similar products, shall be of highest quality, made by reputable, recognized manufacturers, and have identifying labels on containers. Paint materials shall be factory mixed except for field catalyzed coatings.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions under which painting will be performed for compliance with application requirements. Do not begin paint application until unsatisfactory conditions have been corrected.

1. Start of painting will be construed as Applicator's acceptance of substrate surfaces and conditions.
 2. Surfaces receiving coatings or fillers must be thoroughly dry and less than maximum moisture content acceptable to paint coating manufacture. Before paint application, verify that moisture content of surfaces, measured with an electronic moisture meter, are less than the following values:
 - a. Gypsum Board and Concrete: 10 percent.
 - b. Wood: 15 percent.
- B. Coordination of Work: Review other Sections in which materials or components are pre-finished or factory-primed to ensure compatibility of the paint system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.

3.02 PROTECTION

- A. Before painting, remove hardware, accessories, electrical plates, lighting fixtures and similar items and protect. On completion of each area, replace above items.
1. Provide barricades and coverings as required to protect work of other trades.
 2. Protect plants, glass, window framing and other exterior finished surfaces from contact with cleaning materials and thoroughly flush with water after contact.
 3. Mask permanent labels and adjacent surfaces from paint application.

3.03 PREPARATION

- A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of size or weight of the item, provide masking and covered protection before surface preparation and painting.
1. Clean surfaces of dust, rust, stains, scale, mildew, grease, oil, deteriorated substrates, bond-breakers, efflorescence and other foreign matter detrimental to the coating's adhesion and performance. Repair voids, cracks, nicks, and other surface defects, with appropriate patching material. Finish flush with surrounding surfaces and match adjacent finish texture.
 2. Spot prime marred or damaged shop coats on metal surfaces with appropriate metal primer.
 3. Provide barrier coats over incompatible primers or remove and reprime with compatible primer.
- B. Concrete and Stucco:
1. Determine alkalinity content of cementitious surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces if alkalinity exceeds that permitted in manufacturer's literature. Surfaces requiring painting or finishing shall be thoroughly dry and cured.
 2. Remove curing, bond-breaker or form-release agents from surfaces to be painted.
 3. Repair surfaces to be painted prior to application of prime and finish coat(s). Repair surface imperfections to match and flush-out with adjacent finish texture and profile. Apply primer to repaired surfaces after patch or fill material has thoroughly dried.
 4. Spot prime exposed metal embeds and plates occurring in the surfaces with a rust inhibitive primer as recommended by paint manufacturer.
- C. Ferrous Metals:
1. Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove grease, oil, mill scale, rust and rust scale and touch-up chipped or abraded places on items that have been shop coated. Remove and reprime incompatible or damaged shop applied primers. Comply with the Steel Structures Painting Council's (SSPC-SP2) recommendations for cleaning of uncoated steel surfaces.
 2. When area will be exposed to view, sand the entire primed area smooth, feather the edge of surrounding undamaged prime coat and spot prime in a manner to eliminate evidence of repair.
 3. Mechanically abrade and wire-brush weld slag from field welds. Grind welds smooth and spot prime.

- D. Galvanized Metal and Aluminum:
 - 1. Thoroughly clean by wiping surfaces with a non-solvent cleaner that will not leave an oily residue. Apply surface conditioner or vinyl-wash pretreatment as required for proper adhesion if required by paint manufacturer. Prime galvanized metal with galvanized metal primer as recommended by paint top-coating manufacturer.
 - 2. Remove roller oil from galvanized coil-stock fabricated metal deck products with suitable cleaner.
 - 3. Clean visible portions of interior throats of galvanized steel ductwork and paint flat black.
- E. Gypsum Board Surfaces:
 - 1. Fill cracks, holes or imperfections in with compatible patching material and smooth off to match adjoining surfaces.
 - 2. Before painting, surfaces shall be tested for dryness with a moisture testing device. Do not apply paint or sealer on gypsum board when the moisture content exceeds 10 percent.

3.04 APPLICATION

- A. Material Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
 - 1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and dried residue.
 - 2. Stir material before application to produce a mixture of uniform density and color. Do not stir partially dried paint or surface film into material.
 - 3. Use only thinners approved by paint manufacturer and only within recommended limits.
- B. General: Apply paint according to manufacturer's written instructions. Use application techniques best suited for substrate and type of material being applied.
 - 1. Paint coatings, surface treatments, and finishes are indicated in the paint schedules.
 - 2. Provide finish coats that are compatible with primers used.
 - 3. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture.
 - 4. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
- C. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
 - 1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer. Sand between applications to produce a smooth, even surface.
 - 2. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
 - 3. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried and until application of another coat of paint does not cause under-lying coat to lift or lose adhesion.
- D. Workmanship
 - 1. Apply each coat of paint evenly and comply with manufacturer's drying time before applying subsequent coats.
 - 2. Finished work shall be uniform, match approved color, texture and coverage, and free from runs, sags, clogging or excessive flooding. Make edges of paint adjoining other materials or colors sharp and clean, without overlapping. Where varnishes or enamel is used, lightly sand, dust and clean undercoats to obtain a smooth finish coat. Sand carefully between each coat of finish on smooth surfaces for good adhesion of subsequent coats.
 - 3. Where clear finishes are required, ensure tinted fillers match wood. Work fillers sufficiently into the wood grain before drying. Wipe excess from the surface and sand smooth when dried.
- E. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve a minimum dry film thickness of 1.5 mils (DFT) per coat, unless thicker coating applications are indicated in Paint Schedules.

- F. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by manufacturer, to material that is required to be painted or finished. Recoat primed and sealed surfaces where evidence of blushing or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects.
- G. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled. Provide level of block fill as scheduled to conform with the following:
 - 1. Level 1 – Medium Full Fill: One coat, spray applied and back-rolled.
 - 2. Level 2 – Full Fill: Minimum block fill required for semi-gloss and gloss finishes. Provide number of coats as required to fill masonry pores and mortar pin-holes, spray applied and back-rolled.
- H. Exterior Steel: Paint exterior structural steel, steel supports, fabrications, embeds, weld plates, perforated metal-plates, railings and other similar metal items.
- I. Exterior Plumbing, Mechanical and Electrical: Items to be painted include, but are not limited to the following:
 - 1. Exposed water, gas, vent piping, pipe hangers or wall brackets, tanks, backflow preventers, conduit, lighting and electrical panels, telephone terminal boxes, galvanized ducts or exhaust hoods shall be painted to match adjacent wall colors.
- J. Interior Plumbing, Mechanical and Electrical: Items to be painted include, but are not limited to the following:
 - 1. Spray paint prime coated grilles and registers (not pre-finished) with enamel or lacquer to match walls and ceilings.
 - 2. Throats of ducts shall be given one coat of flat black paint, wherever visibility of the interior of the duct is allowed through registers or other similar items. At fiber lined duct, use black latex paint.
 - 3. Do not paint galvanized interior items, including ductwork, piping or conduit.
 - 4. Mechanical or electrical equipment on or adjacent to walls or surfaces scheduled for painting, shall be disconnected, using workmen skilled in appropriate trades, and moved temporarily to permit painting of surface. Following completion of painting, replace and reconnect items.
- K. Interior Miscellaneous Steel: Paint interior metal railings and handrails, ladders and ladder platforms. Paint interior metal structural steel columns to height of bottom of roof joists.
- L. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.
- M. Floor Sealers (Office Areas): Application of liquid sealer shall be performed by an approved applicator of the liquid sealer manufacturer.
 - 1. Location: At office areas not scheduled to receive floor coverings.
 - 2. Floor Slab Cleaning: Prior to application of liquid sealer, inspect and thoroughly clean slab with auto scrubber to ensure that it is clean and free of salts, laitance, dust, grease, oils or other contaminants that might inhibit the proper application of the liquid sealer.
 - 3. Within twenty-four hours after air-dry period, spray-apply liquid sealer at a minimum coverage rate 200 sq. ft. per gallon in accordance with manufacturer's instructions.

3.05 CLEANING

- A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from Project site.
 - 1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping without scratching or damaging adjacent finished surfaces.

3.06 PROTECTION

- A. Protect work of other trades, whether being painted or not, against damage from painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.

- B. Provide "Wet Paint" signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings provided by others to protect their work.

3.07 COLOR FINISH SCHEDULES

- A. Color Schedule: Refer to the "Finish Schedule" on the Drawings for designated colors and finishes.
 - 1. Colors indicated may be from various manufacturer's color line. Manufacturers supplying paint shall match these colors and shall prepare and submit sets of samples for all colors and sheens for approval. If a specific surface or item receiving a paint finish does not have a specific color indicated or selected by the Architect, obtain clarification from the Architect.
- B. Finishing of the following listed items and materials will not be required and shall be protected:
 - 1. Finished products such as ceramic tile, glass, brick, flooring and acoustical tiles, and metal-tee grids.
 - 2. Pre-finished products such as wood folding partitions and doors, wood or plastic-laminate casework, and elevator cabs.
 - 3. Stainless Steel, brass, bronze, copper, chromium, anodized aluminum; specially finished fabrications such as synthetic-stone, and powder-coat enamel, unless otherwise indicated.

3.08 EXTERIOR PAINT SCHEDULE

- A. Concrete Unit Masonry: Apply to exterior concrete masonry unit construction indicated to be painted. Back-roll 2nd and 3rd coat. (Refer to Section 07 19 00 "Water Repellent Sealers" for use on concrete masonry units indicated to receive surface applied sealers.)
 - 1. 1st Coat: Masonry concrete block filler for exterior painted masonry application. Provide Level 1 Fill; DFT: 8.0 mils.
 - a. DE: SBSL00-1 Smooth BLOCFIL Select
 - b. PPG: Speedhide Block Filler
 - c. S-W: B25W25 PrepRite Block Filler
 - 2. 2nd Coat: Masonry Primer.
 - a. DE: ESSL00 Eff-Stop
 - b. PPG: Speedhide Exterior
 - c. S-W: A24W300 Luxon Primer
 - 3. 3rd Coat: Flat, waterborne, 100% acrylic-emulsion latex paint for exterior application.
 - a. DE: W 720 Acri-Hues
 - b. PPG: 6-411 Speedhide Exterior Flat
 - c. S-W: 6808 Acrylux Latex Flat
- B. Site-cast Concrete: Apply to exterior cementitious surfaces as indicated. Precast concrete lintels, beams, caps, sills, etc. at exterior of buildings shall not be painted, unless specifically noted. Back-roll 2nd coat.
 - 1. 1st Coat: Alkali-resistant acrylic-latex concrete primer for exterior application. DFT: 1.8 mils.
 - a. DE: ESSL00 Eff-Stop
 - b. PPG: Perma Crete Acrylic Primer
 - c. S-W: A24W300 Luxon Primer
 - 2. 2nd and 3rd Coat: Flat, waterborne, 100% acrylic-emulsion latex paint for exterior application.
 - a. DE: W 720 Acri-Hues
 - b. PPG: 6-411 Speedhide Exterior Flat
 - c. S-W: 6808 Acrylux Latex Flat
- C. Ferrous Metal: Apply to exposed steel such as metal decking, beams, columns, connectors, metal doors and frames, grilles, light fixture standards in parking areas, metal handrails, sectional and coiling doors, metal canopy overhangs and other exposed miscellaneous ferrous metals that are not pre-finished.
 - 1. 1st Coat: Ferrous Metal Grey Primer. Rust-inhibitive, 100% alkyd metal primer for exterior application. DFT: 1.5 mils. Primer is required on shop-primed items.
 - a. DE: BRPR00-1 Bloc-Rust Primer
 - b. PPG: Pitt-Tech DTM Acrylic Primer.

- c. S-W: B50AZ8 Kem Bond HS Primer
- 2. 2nd and 3rd Coat: Satin, acrylic-enamel for exterior application. DFT: 2.0 mils.
 - a. DE: W-9 Syn-Lustro
 - b. PPG: 7-Line Industrial Alkyd
 - c. S-W: B66-200 DTM Acrylic Coating
- D. Zinc-Coated Metal or Unfinished Aluminum: Apply to exposed mill-finish aluminum or galvanized metal such as parapet copings, louvers and metal flashings. Clean metal to remove foreign matter or any coating applied by the metal manufacturer. Apply Surface Conditioner or Vinyl Wash Pretreatment as required by paint manufacturer.
 - 1. 1st Coat: Galvanized Metal Primer: Metal primer for exterior application. DFT: 1.8 mils.
 - a. DE: GAPR00 Galv-Alum Metal Primer
 - b. PPG: Pitt-Tech DTM Acrylic Primer.
 - c. S-W: B66-310 Pro-Cryl Universal Primer
 - 2. 2nd Coat and 3rd Coat: Satin, acrylic-enamel for exterior application. DFT: 2.0 mils.
 - a. DE: W-9 Syn-Lustro
 - b. PPG: 6-411 Speedhide Exterior
 - c. S-W: B66-200 DTM Acrylic Coating
- E. Exterior Gypsum Soffit Board: Apply to exterior grade gypsum board soffits:
 - 1. 1st Coat: Acrylic-latex primer for exterior application.
 - a. DE: UGSL00-1 Ultra-Grip Select
 - b. PPG: Seal-Grip Universal Latex Primer
 - c. S-W: A42W8041 Latex Primer
 - 2. 2nd and 3rd Coat: Flat, waterborne, 100% acrylic-emulsion latex paint for exterior application.
 - a. DE: W 720 Acri-Hues
 - b. PPG: 6-411 Speedhide Exterior
 - c. S-W: A-100 Flat A6 Series.

3.09 INTERIOR PAINT SCHEDULE

- A. Ferrous Metals: Apply to exposed metals such as hollow metal doors and frames, metal beams, columns, braces, steel wall embeds and plates, stair and hand railings, ladders, and other exposed miscellaneous metals.
 - 1. 1st Coat: Ferrous Metal Grey Primer. Rust-inhibitive, acrylic metal primer for interior application. Primer is required on shop-primed items.
 - a. DE: BRPR00 Bloc-Rust
 - b. PPG: Multi-Prime Quick-Dry Primer
 - c. S-W: B66-310 Pro-Cryl Primer
 - 2. 2nd and 3rd Coat: Semi-Gloss, acrylic-enamel.
 - a. DE: W-9 Syn-Lustro
 - b. PPG: Speedhide Exterior
 - c. S-W: B66-560 Pro Industrial

END OF SECTION

SECTION 10 14 00

TRAFFIC-CONTROL SIGNS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Site traffic control signs.

1.02 SUBMITTALS

- A. Shop Drawings: Show fabrication and installation details for post and panel/pylon signage.
 - 1. Include plans, elevations, sections, details, and attachments to other work.
 - 2. Provide graphic layout of text for each sign type.

1.03 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm experienced in designing and producing metal sign fabrications similar to those indicated for this Project.
- B. Regulatory Requirements: Comply with City of Salt Lake regulatory requirements for sign locations and the following:
 - 1. 2010 ADA "Standards for Accessible Design".
 - 2. 2021 International Building Code, Chapter 11.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Metals: New stock, free from damage, scratches and warpage.
 - 1. Steel Shapes: ASTM A 36.
 - 2. Galvanized Steel Sheets: ASTM A 653, with G90 zinc coating.
 - 3. Steel Tubing: ASTM A 500.
 - 4. Aluminum Sheet: ASTM B 209, 0.080 inch minimum thickness.
- B. Paint: Non-fading, polyurethane enamel.

2.02 ACCESSORIES

- A. Bolts and Nuts: Provide nonferrous-metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance.

2.03 FABRICATION

- A. Graphics: Refer to Drawings for sign locations and specific text and graphic enumeration. Sign types include:
 - 1. Fire-Lane Control.
 - 2. ADA Accessible Parking.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing sign fabrications to in-place construction. Include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws, and other connectors.
- C. Verify that items, including anchor inserts, are sized and located to accommodate signs.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Excavation: Excavate hole depths for sign foundation approximately 24 inches below finished grade or as indicated. Reconstruct subgrade that is not firm, undisturbed, or compacted soil, or that is damaged by accumulated water, or construction activities by excavating a further 12 inches, backfilling with satisfactory soil, and compacting to original subgrade elevation.
- B. Locate signs and accessories where indicated, using mounting methods of types described and complying with manufacturer's written instructions.
 - 1. Install signs level, plumb, and at heights indicated, accurately fitted together with sign surfaces free of distortion and other defects in appearance.
 - 2. Mechanical Fasteners: Use nonremovable mechanical fasteners placed through predrilled holes. Attach signs with fasteners and anchors suitable for secure attachment to substrate as recommended in writing by sign manufacturer.

3.03 CLEANING AND PROTECTION

- A. After installation, clean soiled sign surfaces according to manufacturer's written instructions. Protect signs from damage until acceptance by Owner.
- B. Touchup Painting: Immediately after installation, clean sign surfaces and repair any damaged graphics.

END OF SECTION

SECTION 10 14 00

TRAFFIC-CONTROL SIGNS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Site traffic control signs.

1.02 SUBMITTALS

- A. Shop Drawings: Show fabrication and installation details for post and panel/pylon signage.
 - 1. Include plans, elevations, sections, details, and attachments to other work.
 - 2. Provide graphic layout of text for each sign type.

1.03 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm experienced in designing and producing metal sign fabrications similar to those indicated for this Project.
- B. Regulatory Requirements: Comply with City of Salt Lake regulatory requirements for sign locations and the following:
 - 1. 2010 ADA "Standards for Accessible Design".
 - 2. 2021 International Building Code, Chapter 11.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Metals: New stock, free from damage, scratches and warpage.
 - 1. Steel Shapes: ASTM A 36.
 - 2. Galvanized Steel Sheets: ASTM A 653, with G90 zinc coating.
 - 3. Steel Tubing: ASTM A 500.
 - 4. Aluminum Sheet: ASTM B 209, 0.080 inch minimum thickness.
- B. Paint: Non-fading, polyurethane enamel.

2.02 ACCESSORIES

- A. Bolts and Nuts: Provide nonferrous-metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance.

2.03 FABRICATION

- A. Graphics: Refer to Drawings for sign locations and specific text and graphic enumeration. Sign types include:
 - 1. Fire-Lane Control.
 - 2. ADA Accessible Parking.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing sign fabrications to in-place construction. Include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws, and other connectors.
- C. Verify that items, including anchor inserts, are sized and located to accommodate signs.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Excavation: Excavate hole depths for sign foundation approximately 24 inches below finished grade or as indicated. Reconstruct subgrade that is not firm, undisturbed, or compacted soil, or that is damaged by accumulated water, or construction activities by excavating a further 12 inches, backfilling with satisfactory soil, and compacting to original subgrade elevation.
- B. Locate signs and accessories where indicated, using mounting methods of types described and complying with manufacturer's written instructions.
 - 1. Install signs level, plumb, and at heights indicated, accurately fitted together with sign surfaces free of distortion and other defects in appearance.
 - 2. Mechanical Fasteners: Use nonremovable mechanical fasteners placed through predrilled holes. Attach signs with fasteners and anchors suitable for secure attachment to substrate as recommended in writing by sign manufacturer.

3.03 CLEANING AND PROTECTION

- A. After installation, clean soiled sign surfaces according to manufacturer's written instructions. Protect signs from damage until acceptance by Owner.
- B. Touchup Painting: Immediately after installation, clean sign surfaces and repair any damaged graphics.

END OF SECTION

SECTION 11 16 10

LOADING DOCK EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes the following:

1. Dock bumpers.
2. Dock levelers.
3. Dock seals.
4. Door track guards.

1.02 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, accessories, details of construction relative to materials, dimensions of individual components, profiles, and finishes.
- B. Shop Drawings: Show details of fabrication and installation. Include plans, elevations, sections, details, and attachments to other work.
1. Provide templates for anchors and bolts anchored to permanent construction.
 2. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring.
- C. Product Test Reports: Based on evaluation of tests performed by manufacturer and witnessed by a qualified independent professional engineer, indicate compliance of dock levelers with requirements of MH 30.1 for determining rated capacity, based on comprehensive testing within the last two years of current products.
- D. Maintenance Data: For loading dock equipment to include in the maintenance manuals specified in Division 1. Include name, address, and telephone number of manufacturer's nearest authorized service representative.
- E. Warranties: Special warranties specified in this Section.

1.03 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer who is an authorized representative of loading dock equipment manufacturer for both installation and maintenance of the type of units required.
1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.
- B. Source Limitations: Obtain loading dock levelers, including dock bumpers and seals, as a complete unit from one source and by a single manufacturer.
- C. Dock-Leveler Standard: Comply with applicable requirements of ASME/ANSI MH 14.1, "Loading Dock Levelers and Dockboards" for construction and operation of dock levelers.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Store and handle dock seals and shelters in a manner to avoid puncture or damage to fabric or frame.

1.05 COORDINATION

- A. Recessed Dock Levelers: Coordinate size and location of pits to ensure proper clearances and operation of equipment. Concrete, reinforcement, and formwork requirements are specified in Section – 03 30 00 "Cast-in-Place Concrete."

1.06 WARRANTY

- A. General Warranty: The special 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 Contractor under requirements of the Contract Documents.
- B. Dock-Leveler Warranty: Submit a written warranty, executed by manufacturer, agreeing to repair or replace dock-leveler components that fail in materials or workmanship within the specified warranty period. Failures include, but are not limited to, the following:
 - 1. Structural failures, including cracked or broken structural support members and load-bearing welds.
 - 2. Deck plate failures, including cracked plate or permanent deformation in excess of 1/4 inch between deck supports.
 - 3. Air-bag system failures, including failure of seals and blowers.
 - 4. Faulty operation of operators, control system, or hardware.
- C. Warranty Period: Five years from date of Substantial Completion.
 - 1. Warranty shall be for unlimited usage of the leveler for the specified rated capacity over the term of the warranty.

1.07 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance by skilled employees of dock equipment Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper equipment operation at rated speed and capacity. Provide parts and supplies as used in the manufacture and installation of original equipment.
 - 1. Perform maintenance, including emergency callback service, during normal working hours.
 - 2. Include 24-hour-per-day, seven-day-per-week emergency callback service.
- B. Continuing Maintenance Service: Provide a continuing maintenance proposal from Installer to Owner, 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 RECESSED DOCK LEVELERS

- A. Manufacturer: The basis-of-design for hydraulic dock levelers is based on the following manufacturer:
 - 1. HK7X8 – Straight Pit; Kelly Dock Systems.
- B. Type: Provide recessed, hinged-lip-type dock levelers designed for permanent installation in concrete pits, of type, function, operation, capacity, size, and construction indicated, complete with controls, safety devices, and accessories required.
- C. Function: Dock levelers shall compensate for differences in height between truck bed and loading platform in the following manner:
 - 1. Platform: 7'-0 wide by 8'-0 long.

2. Vertical Travel: Minimum working range shall be 12 inches above and 12 inches below adjoining platform level. Provide an operating range above platform level of sufficient height to enable lip to extend and clear truck bed before contact.
 3. Lip Operation: Provide manufacturer's standard mechanism that automatically extends and supports hinged lip on ramp edge with lip resting on truck bed over dock leveler's working range, allows lip to yield under impact of incoming truck, and automatically retracts lip when truck departs.
 - a. Length of Lip Extension: Not less than 20 inches from ramp edge and not less than 12 inches in front of dock bumpers.
- D. Operation: Provide manufacturer's standard operating system as follows:
1. Spring Operating System: Equip leveler with a packaged spring unit. Include dock-leveler supports controlled by release chain for lowering ramp below platform level extending lip.
- E. Rated Capacity: Provide dock levelers capable of supporting a total gross load indicated below without permanent deflection or distortion, as determined by actual tests complying with requirements of MH 30.1 for rated capacity.
1. Total Load: Not less than 40,000 lb.
- F. Safety Devices: Provide manufacturer's standard and optional safety devices as follows:
1. Toe Guards: Equip open sides of rising ramp over entire upper operating range with metal toe guards mounted flush with ramp edges and projecting below ramp.
 2. Cross-Traffic Support: Provide manufacturer's standard method of supporting ramp at platform level in stored position with lip retracted. Provide a means to release supports to allow ramp to descend below platform level.
 3. Maintenance Strut: Provide an integral strut to positively support ramp in up position during maintenance of dock leveler.
 4. Interlocks: Provide control interlocks between dock leveler and other dock equipment as follows:
 - a. Leveler to Truck-Restraint Interlock: Leveler will not operate while truck restraint is not engaged.
- G. Construction: Fabricate dock-leveler frame from structural- and formed-steel shapes. Fabricate platform, including hinged lip, from nonskid steel plate. Fabricate entire assembly to withstand deformation during both operating and stored phases of service. Chamfer lip edge to minimize obstructing wheels of material-handling vehicles. Include two dock bumpers attached to frame.
1. Clean Pit Frame: Provide leveler framing designed to support leveler at sides of pit, with no side-to-side supports at front and back of pit floor.
 2. Curb Angles: Provide 3-by-3-by-1/4-inch galvanized steel curb angles for edge of recessed leveler pit, with 1/2-inch-diameter by 6-inch-long concrete anchors welded to angle at 6 inches o.c.
 3. Self-Forming Pit: Provide manufacturer's standard prefabricated self-forming steel form system for poured-in-place construction of concrete pit.
- H. Finish and Color: Manufacturer's standard paint applied to factory-assembled and -tested dock levelers before shipping. Paint toe guards yellow to comply with ANSI Z535.1, and paint remainder of surfaces in manufacturer's standard color.
- I. Accessories: Equip units with manufacturer's standard accessories as follows:
1. Night Locks: Provide manufacturer's standard means to prevent extending lip and lowering ramp when overhead doors are locked.

2.02 DOCK SEALS

- A. Manufacturer: The basis-of-design for dock seals is based on the following manufacturer:
1. DSH Foam Dock Seal; Kelley Dock Systems.
- B. General: Provide manufacturer's standard dock seals consisting of fabric-covered foam pads designed to compress under pressure of truck body to form an airtight seal at jambs and head of loading dock openings.

- C. Size of Jamb Pads: Provide jamb pads not less than 12 inches wide and 10 inches deep, sized to suit opening height.
- D. Head Curtain: Provide projecting type head curtain of same depth as jamb pads, sized to suit opening width, and as follows:
 - 1. Drop Height: Not less than 24 inches.
- E. Construction: Provide manufacturer's standard construction consisting of single- or double-ply, coated, fabric-covered, urethane-foam core with supporting frame.
 - 1. Cover Fabric: Vinyl-coated nylon cover fabric with minimum total weight of 40 oz./sq. yd.
 - 2. Fabric Color: Provide colors as selected by Architect from manufacturer's standard colors.
 - 3. Guide Strips: 4-inch- wide, coated, nylon guide strips on jamb pads.
 - 4. Pleated Protectors: Provide protectors on face of jamb pads of overlapping layers of coated fabric attached to base fabric.
 - a. Wear Exposure: 8 inches.
 - 5. Steel Support Frame: Steel channel frame of manufacturer's standard weight and shape and finish, with steel mounting hardware.

2.03 DOCK BUMPERS

- A. Laminated-Tread Bumpers: Provide units of 10-inches in height, fabricated from multiple plies cut from fabric-reinforced rubber tires to a uniform thickness of 6-inches. Laminate plies under pressure on 3/4-inch-diameter, steel supporting rods that are welded and bolted to 1/4-inch-thick, structural-steel angle closures with predrilled anchor holes. Acceptable products include:
 - 1. B610-14F; Kelley Dock Systems.
- B. Anchorage Devices: Provide anchor bolts, nuts, washers, and other anchorage devices as required to fasten bumpers securely in place and to suit installation type indicated. Hot-dip galvanize anchorage components.

2.04 DOCK ACCESSORIES

- 1. Door Track Guards: 48" high, urethane-coated, 1/4 steel plate in z-profile bent shape with sloped safety top and welded base plate. Acceptable products include:
 - a. OM8048; Omega Industrial Products.
 - b. DT48; Savety Yellow Products.

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 loading dock equipment.
- B. Examine roughing-in for electrical systems for dock equipment to verify actual locations of connections before installation.
- C. Examine walls and floors of pits for suitable conditions where recessed dock equipment is to be installed. Pits shall be plumb and square, and properly sloped for drainage from back to front of dock.
- D. Proceed with installation of dock equipment only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. General: Coordinate installation of loading dock equipment indicated to be attached to or recessed into concrete or masonry, and furnish anchoring devices with templates and instructions for their installation.
- B. Clean recessed pits of debris.

3.03 INSTALLATION, GENERAL

- A. General: Comply with manufacturer's detailed written instructions for installing loading dock equipment.
 - 1. Install equipment, motor, pump, fans, control stations and wiring, safety devices, and accessories as required for a complete installation.
- B. Electrical Connections: Rough-in electrical connections according to requirements in Division 16.

3.04 DOCK-BUMPER INSTALLATION

- A. Attach dock bumpers to structure in a manner that complies with requirements indicated for spacing, arrangement, and position relative to top of platform and anchorage.
 - 1. Bolted Attachment: Attach dock bumpers to preset anchor bolts embedded in concrete or to cast-in-place inserts or threaded studs welded to embedded steel plates or angles. If preset anchor bolts, are not provided, attach dock bumpers by drilling and anchoring with expansion anchors and bolts.

3.05 DOCK-LEVELER INSTALLATION

- A. Set curb angles in concrete with tops flush with platform. Fit exposed connections together to form hairline joints.
- B. Attach leveler securely to loading platform construction according to manufacturer's written instructions, flush with adjacent dock surfaces and square to recessed pit.
- C. Recessed Dock Levelers: Coordinate forming recessed pit for dock levelers to ensure that recess is adequate to accommodate leveler in proper relation to loading platform.

3.06 DOCK-SEAL INSTALLATION

- A. Attach supporting frames securely to building structure in proper relation to openings, dock bumpers, and dock levelers to ensure compression of dock seals when trucks are positioned against dock bumpers.

3.07 ADJUSTING

- A. Adjust loading dock equipment for safe, efficient operation.
- B. Test dock levelers and lifts for vertical travel within operating range indicated.

3.08 CLEANING AND PROTECTING

- A. Restore marred, abraded surfaces to their original condition.
- B. Provide final protection and maintain conditions in a manner that ensures loading dock equipment is without damage or deterioration at the time of Substantial Completion.

3.09 DEMONSTRATION

- A. Startup Services: Engage a factory-authorized service representative to perform startup services and to train Owner's maintenance personnel as specified below:
 - 1. Test and adjust controls. Replace damaged and malfunctioning controls and equipment.
 - 2. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.

END OF SECTION

SECTION 21 13 13

WET-PIPE SPRINKLER SYSTEMS

PART 1 – GENERAL

1.1 REQUIREMENTS

- A. Conform to applicable provisions of the General Conditions, Special Conditions, and the General Requirements.
- B. Unless otherwise shown on the approved construction documents or otherwise specified, all materials and equipment used in installation of the fire protection system shall be listed and approved for intended service by Underwriters Laboratories, Inc. (UL) and Factory Mutual (FM). All system components shall be standard products of the latest design of the manufacturer. Equipment and material used shall generally be from a consistent manufacturer.
- C. Provide temporary fire protection during construction as required by the Building Code and the Fire Marshal.
- D. The work included in this contract consists of furnishing all labor, materials, equipment, tools, and services, and includes all costs of permits and all costs whatsoever which may be required to install complete, properly working systems as described herein.
- E. See Division 26 for electrical work and building fire alarm system.
- F. Contractor shall verify prior to preparation of any documents, Insurance Carriers requirements for this project. Such data may be found in general conditions, general requirements, or other portions of the specification manual.
- G. This Contract shall begin at point of connection to the underground riser supply line. Coordinate required work with Utility Contractor. This point of connection may occur at 5'-0" beyond building or at flange connection at base of riser.

1.2 GENERAL CONDITIONS AND SPECIAL CONDITIONS

- A. Bidding requirements, general conditions, general requirements, appendices, and addendums apply to the work under this section as depicted in Project Specification Manual.
- B. The Contractor shall examine existing conditions and related work required for the design and installation of the fire protection system required under this section of the Specifications. The contractor shall provide a written report to the Architect describing any conditions which would prevent proper provisions of this work. Commencement of work without reporting unsuitable conditions to the Architect constitutes acceptance of conditions to the Contractor. The Contractor shall be required to perform any necessary removal, repair, or replacement of work caused by unsuitable conditions which is unreported as described herein, at no additional cost to the owner.

1.3 WATER SERVICE/SUPPLY

- A. The Contractor shall conduct a flow test and determine volume and pressure of incoming water supply from water flow test data. Test shall be conducted in accordance with NFPA-291. Data to be used in hydraulic calculations shall include a minimum of 5 psi or 10% safety factor (whichever is greater) on static and residual pressures and additional seasonal safety factors. Local authorities or Insurance may require additional safety factors.
- B. The connection to water service main and service line for the fire sprinkler system(s) shall be provided as indicated on the approved civil site utility construction documents and shall be furnished and installed by the Contractor complete including all required backflow prevention or detection devices (where required by Authorities having Jurisdiction).
- C. Where the water supply available is not capable of providing the necessary demand of the sprinkler system, an approved Automatic Fire Pump shall be required.

1.4 SUPERVISORY AND ALARM FACILITIES

- A. Equipment necessary to accomplish the required water flow and supervisory alarm initiation shall be furnished and installed under this section of the specifications. Water flow detection and supervisory devices shall be Listed and Approved as specified herein.
- B. Coordination of all wiring with electrical and/or alarm Subcontractors shall be complete in all respects for a complete system.
- C. Interface system with fire and smoke alarm system (Division 26 of Specification). Interface with building control and/or energy management systems may also be required. This work shall be by an Electrical/Fire Alarm Engineer/Contractor.
- D. Paddle-type water flow indicators with adjustable pneumatic retard chamber (0-90 seconds) shall be provided to indicate water flow for the new each sprinkler system.
- E. Valve supervisory switches shall be provided for all new valves controlling the water supply to each sprinkler system.
- F. All electrical wiring of alarm and supervisory devices into the detection and fire alarm system shall be done under.
- G. Electrical/Fire Alarm Contractors shall provide monitoring (off site) of sprinkler systems exceeding 100 sprinklers.

1.5 REGULATORY REQUIREMENTS

- A. Hydraulic Calculations and Design Drawings: Calculations and drawings shall be prepared by a qualified registrant and bear the stamp of the Engineer of Record, the approval of the Fire Protection Consultant, the approval of Authority Having Jurisdiction, and (if required) Owner's fire insurance underwriter prior to submittal to Architect and Fire Protection Consultant for their records.
- B. This Contractor is directed to the fact that these specifications are performance type meaning that at the time of submission of bid the Contractor has contacted ALL governing agencies as to the scope of work to be done for the entire project as outlined herein.
- C. If there is a conflict between the referenced standards, codes, or authorities having jurisdiction; then it shall be the Contractor's responsibility to bring the conflict to the attention of the Owner or his/her Agent immediately in an R.F.I. (Request for Information) format for resolution prior to commencement of any additional work.

- D. All work shall conform to the requirements of the applicable portions of the National Fire Protection Association (NFPA) Standards and Recommended Practices (including Appendices) and the Authority having Jurisdiction.
- E. All work, materials, and equipment shall conform to all Local, State and Federal Codes as well as all other Authorities having jurisdiction. If alternate editions of aforementioned standards, or additional standards are required then they shall be applied as accepted by Local and State codes.
- F. The Contractor shall be responsible for filing all documents, paying all fees, and securing all permits, inspections, and approvals necessary for conducting this work.

1.6 EXTRA MATERIALS

- A. Furnish under provisions of Division 1.
- B. Provide extra sprinklers under the provisions of NFPA 13. In addition, a minimum of two (2) spare sprinklers of each type and temperature installed shall be provided.
- C. Provide two (2) spare suitable wrenches for each sprinkler type.
- D. Provide metal storage cabinet in location designated by Architect/Owner's representative

1.7 INTENT OF SPECIFICATIONS

- A. It is intended that the work performed pursuant to these specifications shall be complete in every respect; resulting in a system installed entirely in accordance with all current applicable codes, standards, manufacturer's recommendations and U.L. listings and FM approvals. All work in general consists of, but is not necessarily limited to, these specifications and the latest accepted code approved design and installation standards.
- B. It is further intended that upon completion of work, the Owner shall be provided with the following:
 - 1. Complete information and drawings describing and depicting the entire system as installed, including all information necessary for maintaining, troubleshooting, and expanding the system at a future date.
 - 2. Complete documentation of system testing.
 - 3. Written certification that the system has been tested and inspected is installed entirely in accordance with the applicable codes, standards, manufacturer's recommendations, U.L. listings, F.M. approvals, etc. and is in proper working order.
 - 4. It is intended that the Contractor be responsible for work with other trades.

1.8 RELATED WORK PROVIDED BY OTHER SECTION

- A. The following related work shall be performed under other sections:
 - 1. Painting of sprinkler piping and valves, including the placement and removal of bags or other protection devices on sprinklers to prevent paint from touching any portion of the sprinkler.
 - 2. Alarm system shall be provided by Electrical and/or Alarm Contractor(s).
 - 3. Concrete filled pipe guard posts for protection of riser(s), backflow assembly, etc. shall be provided where equipment or materials are subject to vehicular traffic.
 - 4. Concrete splash blocks at main drain, inspector's test outlets and auxiliary drain outlets, if necessary.

1.9 WORK TO BE PERFORMED

- A. Complete automatic wet pipe sprinkler system protection throughout the project in accordance with these specifications and/or drawings. Including, but not limited to the following:
1. Automatic Fire pump with test loop, flow meter, by-pass, and all appurtenances.
 2. Valve diagrams, pipe markers, metal signs and riser design placards.
 3. Operating and maintenance manual.
 4. New 4-way siamese-type fire department connection (F.D.C.) for A.S. system with National Standard Threads (N.S.T.) or as required by local fire department. Provide with check valve. Automatic drip is required if F.D.C. is not remotely located. A Stortz connection may be required by The Authority Having Jurisdiction.
 5. Install A.S. system water flow indicating equipment and valve supervisory devices on all devices and valves. Wiring shall be by Electrical and/or Alarm Contractor(s).
 6. Inspector's test and auxiliary drain locations necessary to test and completely drain each A.S. sprinkler system.
 7. Shop drawings, fabrication drawings, equipment submittals, record drawings and other submittals required herein.
 8. Testing of new A.S. system.
 9. Guarantee all new equipment and systems for a one-year period after date of substantial completion as determined by Architect, Owner or His/her Agent and Contractor.
 10. Repair all damage resulting from this work, including all materials, fittings, and fixtures. All pipe openings shall be closed so as to prevent obstructions and damage.
 11. Sleeves and related fire rated seals and waterproofing commensurate with the penetration.
 12. Inserts, hangers, clamps, earthquake sway bracing, etc., as required to hang and support piping in accordance with NFPA and/or this specification.
 13. Furnishing and/or installing backflow assembly (ies) if required; and having said assembly (ies) tested and approved by a certified technician prior to request for final inspection. Assembly shall be approved for such use by authority having jurisdiction.
 14. Accuracy of prefabricated pipe, location of sprinklers and deflectors (per NFPA and inspections), field fit of piping, piping elevations, riser nipple lengths and dimensioning.

1.10 QUALITY ASSURANCE

- A. Installer Qualifications: Installation and alterations of fire protection piping, equipment, specialties, accessories, and repair and servicing of equipment shall be performed only by a qualified installer. The term qualified means experienced in such work (experienced shall mean having a minimum of 5 previous projects similar in size and scope to this project), familiar with all precautions required and has complied with all the requirements of the Authorities having jurisdiction. The installer shall be licensed with the State and Local Authorities having jurisdiction. Submit evidence of such qualifications to the Owner or his/her Agent with submission of bid.

1.11 DEFINITIONS

- A. Contractor: The Fire Protection Contractor and any of his/her sub-contractors, vendors, suppliers, or fabricators.
- B. Provide: Furnish and install.
- C. Furnish: Purchase and deliver to other trades or Owner for installation.
- D. Install: Install materials, equipment or assemblies furnished by other trades or Owner.
- E. Concealed: Where used in connection with installation of piping and accessories, shall mean that hidden from sight as in chases, furred spaces, pipe shafts, or above suspended ceilings. "Exposed" shall mean "not concealed" as defined above.

- F. Owner: Owner or his/her designated Representative.
- G. Fire Protection Consultant:
 - 1. Kraemer Consulting Engineers, PLLC.

1.12 SUBMITTALS FOR ENGINEER REVIEW

- A. Within 30 days after award of contract, the Contractor shall submit manufacturer's data sheets, hydraulic calculations, catalog cut sheets, shop drawings and data on devices for all necessary approvals prior to fabrication of materials, refer to Division 1 for quantities and format.
- B. Hydraulic Calculations and Design Drawings: Calculations and drawings shall be prepared by a qualified registrant and bear the stamp of the Engineer of Record, the approval of the Fire Protection Consultant, the approval of Authority Having Jurisdiction, and (if required) Owner's fire insurance underwriter prior to submittal to Architect and Fire Protection Consultant for their records.
- C. Contractor shall submit complete packages. Partial submittals will be returned without further explanation.
- D. Drawings shall have the Fire Protection Consultants stamp of approval prior to submittal to the Authority Having Jurisdiction.
- E. No extension of the contract time will be granted for the Contractor's failure to allow sufficient time for review and processing, or for shop drawings which have been returned due to improper submission.
- F. The Contractor will not be authorized to start any portion of the work until the shop/fabrication drawings, catalog cuts and other required submittals for that portion are received, reviewed, and approved by all required parties.
- G. The Owner or his/her Agent, Architect and Fire Protection Consultant shall review all submittals for conformance to these specifications.
- H. Contractor may submit for review and approval any proposed substitution of materials from that specified, with material submittals.
- J. If submittals or proposed substitutions, upon review, are found not to conform to the requirements of these specifications, the Contractor shall be required to resubmit with modification. The Contractor shall be responsible for the Owner's expenses for subsequent revisions of rejected submittals necessitated by the Contractor's failure to make the requested modifications. Such extra fees shall be deducted from payments by the Owner to the Contractor.
 - 1. REVIEWED - NO EXCEPTIONS (Contractor Resubmittal Not Required)
Reviewed manufacturer and equipment specifications. Appears to be in conformance with design drawings/specifications.
 - 2. REVIEWED - MAKE CORRECTIONS NOTED (Contractor Resubmittal Not Required)
Reviewed manufacturer and equipment specifications. Appears to be in conformance with design drawings/specifications. Minor adjustments required to the equipment options/accessories. Resubmittal is not required if written acknowledgement is sent to the General Contractor and Architect that these items will be provided as corrected. The sub-contractor shall also provide final record submittal to the general contractor.
 - 3. REVIEWED - FOR RECORD ONLY (Contractor Resubmittal Not Required)
Reviewed only for coordination purpose only of another trade engineering submittals or contractor generated shop-drawings. (Often these are contractor generated installation drawings or 3rd party sealed design drawings (typically seismic engineering for MEP equipment/piping)).

4. REVISE & RESUBMIT (Contractor Resubmittal Required)
Specific manufacturer is acceptable. Equipment model, application, capacity, design parameters, code listing, testing listing is not acceptable or not provided. Resubmittal is required and all engineers' comments shall be addressed in summary memo attached with the resubmittal.
 5. REJECTED (Contractor Resubmittal Required)
Specific manufacturer is not acceptable and rejected. The manufacturer is not listed within project specs and was not prior approved within the timeframe required. Other model types/applications produced by the manufacturer will not be accepted.
- K. Contractor shall address all comments in written form and include with any resubmittal.
- L. One set of drawings bearing the Fire Protection Consultant's approval stamp, Engineer of Record stamp, and the approval of the Authority Having Jurisdiction shall be submitted to the Engineer and Architect for their records.

1.13 MANUFACTURER'S DATA

- A. The Contractor shall submit with his/her bid, manufacturer's data sheets showing the type and model of all equipment or material proposed. This information shall include, but not be limited to:
1. Type of pipe.
 2. Hangers.
 3. Valves.
 4. Pipe fittings/joining methods.
 5. Sprinklers.
 6. Water flow devices.
 7. Supervisory devices.
 8. Water flow alarms.
 9. Fire Department Connection(s).
 10. Escutcheons.
 11. Fire rated and waterproof penetration seals.
 12. Pressure Gauges.
 13. Hose racks, including hose, hose valve, and nozzle (where required).
 14. Nozzles (where required).
 15. Fire Pump and all appurtenances.
- B. When a data sheet shows more than one product, the proposed product shall be clearly indicated by arrows or other suitable means. This includes sprinkler orifice sizes, finishes, and temperature ratings.

1.14 SHOP/FABRICATION DRAWINGS

- A. Shop/Fabrication drawings shall be at a minimum scale of 1/8 inch equals 1'-0" for plans. Plans shall include all required information as required in NFPA-13. Provide additional sprinklers (over code minimum quantities) to obtain symmetrical ceiling layouts. Provide sprinklers as required, in accordance with NFPA-13 for obstructions and ductwork.
- B. Design shall be based upon all of the latest architectural, structural, heating and ventilating, plumbing, electrical and owner's fixture, rack, and equipment drawings, including addendums, etc.

1.15 OPERATION AND MAINTENANCE MANUAL

- A. Within 30 days of completion of the work, the Contractor shall provide the Owner with one (1) electronic copy (in pdf format) copy of a manual including, but not limited to:
 - 1. 11"x17" reduced copies of the "record" drawings.
 - 2. A detailed description of routine maintenance required or recommended, or as would be provided under a maintenance schedule and detailed maintenance and installation manuals/instructions for all equipment installed including a list of recommended spare parts and service directory
- B. Within 30 days of the completion of the work, one (1) electronic copy of the manual shall be delivered to the Owner.

1.16 RECORD DRAWINGS

- A. The Contractor shall maintain on the site an accurate record of all changes made to the system layout from that shown on the approved drawings.
- B. At least one set of approved drawings with all required stamps of approval shall be maintained on-site and made available to all Authorities having jurisdiction on demand during the construction phase of work.

1.17 VALVE DIAGRAMS

- A. At the completion of the work, provide a small scale of the building(s) indicating the location of all control valves, low point drain(s), and inspectors test(s). The plan shall be neatly drawn, and color coded to indicate the portion of the building protected by each system, framed under glass (not plastic), and permanently mounted on the wall adjacent to each sprinkler riser.

1.18 CHANGES

- A. Make no changes in installation from layout as shown on the approved drawings unless change is specifically approved by the Engineer. This does not include minor revisions for the purpose of coordination, or to clear ducts or obstructions.
- B. Any changes made other than stated above are at the Contractor's own expense and responsibility.

1.19 LEAK DAMAGE

- A. The Contractor shall be responsible during the installation and testing period of the sprinkler system for any damage to the work by others, to the building, its contents, etc. caused by leaks in any equipment, by unplugged or disconnected pipes, fittings, etc., or by overflow, and shall pay for the necessary replacement or repairs to work of others, damaged by such leaks.

1.20 FREIGHT AND HAULING

- A. Deliver materials to the job site, unload, and store in a location determined by the Owner's Representative and General Contractor.

1.21 BASE BID

- A. The base bid shall be lump-sum or in accordance with Division I of specifications.
- B. The Contractor shall indicate the number of sprinklers included in the base bid, including the number of sprinklers allowed for obstructions and ductwork.

1.22 CLEANUP

- A. Maintain the premises free from accumulation of waste material or rubbish caused by this work.
- B. At the completion of the work, remove all surplus materials, grease, oil, etc. from piping, tools, etc., and leave premises in a neat, clean workmanlike manner.

1.23 SAFETY

- A. All work shall be performed in compliance with the Occupational Safety and Health Act of 1970 and Construction Safety Acts Standards (or current).

1.24 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and protect products to site under provisions of Division 1.
- B. Store products in shipping containers and maintain them in place until installation. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.25 EMERGENCY SERVICE

- A. During the warranty period, the Contractor shall provide emergency repair service for the entire automatic sprinkler system. This service shall be provided on a 24-hour per day, 7 day per week basis. Coordinate details with Owner's Representative.

1.26 SPARE PARTS AND SPECIAL TOOLS

- A. Contractor shall install code approved metal sprinkler cabinet(s) containing sprinklers of all types, finishes, and temperature ratings used and two (2) sets of sprinkler wrenches compatible with each type of sprinkler provided. The cabinets shall be installed at the locations approved by the Owner and NFPA requirements. Sprinkler and cabinet quantities shall be per NFPA-13.
- B. The Contractor shall supply the Owner with two (2) complete sets of special tools and equipment necessary to perform routine maintenance on the sprinkler systems.

1.27 FINAL APPROVAL AND ACCEPTANCE

- A. Final approval and acceptance of the work will not be given by the Owner until:
 - 1. The completed sprinkler system(s) has/have been inspected, tested, and approved by the Owner, Architect, and all other Authorities having jurisdiction.
 - 2. Required submittals, system operation and maintenance manuals, "record" drawings, spare parts, and special tools have been provided to, reviewed, and accepted by the Owner.

1.28 GUARANTEE PERIOD

- A. The following guarantee is a part of the specifications and shall be binding on the Contractor.
- B. "The Contractor guarantees that this installation is free from mechanical defects. He agrees to replace or repair to the satisfaction of the Architect any part of the installation which may fail within a period of one year after date established below, provided that such failure is due to defects in the materials and workmanship or to failure to follow the specifications and drawings. Warranty of the Contractor furnished equipment, or systems shall begin on the date the system or equipment is placed in operation for beneficial use of the Owner or occupancy by the Owner, whichever occurs first."

PART 2 – PRODUCTS

2.1 DESIGN CRITERIA

- A. Provide wet-pipe sprinklers in all areas as required by NFPA, Authorities having jurisdiction, these specifications and/or approved construction documents.
 - 1. Provide ESFR wet pipe system over warehouse area. Refer to NFPA 13 and FM Global Data sheet 2-2 for spacing requirements.
 - 2. Provide wet pipe system over office areas conforming to NFPA 13 and FM Global data sheet 3-26.
 - 3. Provide wet pipe system over production areas in accordance with NFPA 13 and FM Global data sheet 3-26.
- B. Design and hydraulically calculate each wet-pipe sprinkler system to produce a discharge density over the most hydraulically demanding area of operation as required by FM Global, NFPA and Authorities having jurisdiction.

2.2 PIPING

- A. Manufacturers:
 - 1. Allied Tube and Conduit (Grinnell)
 - 2. Western Tube and Conduit Corp.
 - 3. Bull Moose Tube Company
- B. Underground outside of building: See Civil Drawings and Specifications for complete description.
- C. Underground inside of building: Class 200 ductile iron with mechanical-restricted joints. The interior of the pipe and fittings shall be cement lined.
- D. Sprinkler system piping or tubing shall meet the requirements of NFPA 13, be U.L. listed and F.M. approved. Contractor shall base his/her bid on the use of any one or a combination of the following: In addition, all pipes shall have a minimum Corrosion Resistance Ratio (CRR) of 1.00 or greater, as per U.L. listings.
- E. Pipe meeting ASTM A-795 and/or A-135 requirements for above grade use. All piping shall be black carbon steel.
- F. Flanges and flanged fittings shall be 175 psi cast iron with standard ring gaskets.
- G. Pipe and fittings shall be listed by Underwriters Laboratories, Inc. and approved by Factory Mutual for use in fire protection systems and designed to withstand a working pressure of not less than 175 psi.
- H. All pipe and fittings exposed to the weather, downstream of all inspector's test valves, between exterior wall and check valve on FDC, or located in a corrosive atmosphere shall be hot-dipped zinc coated (galvanized).
- I. Flexible couplings shall be U.L. and F.M. approved.
- J. Pipe penetrations through masonry and fire-rated construction shall be sleeved and sealed with fire rated seals commensurate with the building construction.
- K. Pipe penetrations through floors and exterior walls shall be approved waterproof seals.

- L. When system piping pierces a foundation wall below grade or is located under the foundation wall, clearance shall be provided to prevent breakage of piping due to building settlement. Do not locate pipe joints within or under a foundation wall and a 1–3-inch clearance shall be provided around piping by use of sleeve for piping piercing a foundation wall. Sleeve properly and fill the clear space with approved waterproof packing.
- M. Use of foreign-made piping or fittings shall not be permitted.
- N. Use of copper or CPVC piping and fittings in accordance with NFPA-13 and pipe listing is permissible where prior-approved only.

2.3 VALVES

- A. Except for miscellaneous small valves, all valves shall be plainly marked with the name or registered trademark of the manufacturer, size of the valve, and U.L. or F.M. identification mark. All valves shall be suitable for 175 psi working water pressure.
- B. All water supply control valves shall be an indicating (OS and Y or Butterfly) type and shall be furnished with a valve supervisory device.
- C. All water supply control, drain, and test valves shall be permanently identified to show their function and the sprinkler system zone they serve.
- D. All valves shall be located within six (6) feet of the floor.

2.4 SPRINKLERS

- A. Manufacturers:
 - 1. Viking
 - 2. Reliable
 - 3. Tyco
- B. Ceiling (Recessed Light Fixtures):
 - 1. Type: Recessed Pendant type with matching escutcheon plate.
 - 2. Sprinkler Finish: Chrome plated.
 - 3. Escutcheon Plate Finish: Chrome plated.
 - 4. Activation: Recessed: Glass bulb type temperature rated for specific area hazard.
- C. Ceiling (Surface mounted light fixtures):
 - 1. Type: Standard pendent type with matching escutcheon plate.
 - 2. Sprinkler Finish: Chrome plate.
 - 3. Escutcheon Plate Finish: Chrome plated.
 - 4. Activation: Recessed: Glass bulb type temperature rated for specific area hazard.
- D. Exposed Area Type:
 - 1. Type: Upright type.
 - 2. Sprinkler Finish: Brass.
 - 3. Activation: Glass bulb type temperature rated for specific area hazard.
- E. Warehouse Area Type:
 - 1. Type: Pendent
 - 2. Sprinkler Finish: Brass
 - 3. Activation: Fusible Link

- F. Sidewall Type:
1. Type: Recessed horizontal sidewall type with matching escutcheon plate and guard.
 2. Sprinkler Finish: Brass.
 3. Escutcheon Plate Finish: Brass.
 4. Activation: Glass bulb type temperature rated for specific area hazard.
- G. Guards: Finish to match sprinkler. Provide where the sprinkler is susceptible to mechanical damage and/or located at less than 7'-0" above floor.
- H. In exposed areas and ceilings, sprinkler activation shall be glass bulb type. Solder type sprinklers shall be acceptable above the warehouse area.
- J. All sprinkler colors shall be factory – applied.
- K. Utilize quick response sprinklers where possible in accordance with NFPA 13.
- L. Sprinklers required due to ceiling projections/obstructions and ductwork are not considered additional sprinklers. The contractor shall be responsible for identifying these locations and providing coverage per code.
- M. Install ordinary, intermediate, and high temperature sprinklers of proper degree rating wherever necessary to meet requirements of NFPA, and Authorities having jurisdiction.
- N. Provide corrosion resistant sprinklers with factory applied coating where sprinkler is to be located in a corrosive atmosphere (locker/shower areas, canopies, etc.).
- O. Provide dry pendent sprinklers with wire guards in all areas where the maintained ambient temperature is less than 40 degrees Fahrenheit; this includes walk-in refrigerators and freezers.
- P. Provide dry pendent sprinklers on dry systems.
- Q. Sprinkler and escutcheon finishes shall be suitable for area or ceiling finish provided. Verify finish of all sprinklers and escutcheons with Owner or his/her Agent prior to ordering.

2.5 HOSE THREADS

- A. Hose threads for hydrants and fire department Siamese connections shall match those of the local Fire Department, and/or shall be National Standard Thread (N.S.T.) type.

2.6 FIRE DEPARTMENT CONNECTION

- A. New fire department connection(s) shall be provided in accordance with the requirements of all Authorities having jurisdiction. Provide with check valve. Approved automatic drip shall be required only where FDC is not remotely located.

2.7 INSPECTOR'S TEST CONNECTIONS

- A. Provide test connection at the most remote portion of each A.S. system, with 1" pipe and valve. Test connection piping shall be connected to sprinkler branch line at least 1-1/4" in diameter and shall discharge outside building through smooth bore brass outlet. The outlet orifice shall be equal to the smallest sprinkler orifice utilized in the sprinkler system.

2.8 HANGERS

- A. Use beam clamps or hang from top chord of joists. Do not hang from bottom chord of joist or bridging.
- B. Trapeze all mains. Verify all hanger types with Structural Drawings and Engineer prior to commencement of any work.
- C. Provide sway bracing. Install in accordance with NFPA-13. Pipe to be generally supported by clamps and rods and secured to overhead construction.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation of fire protection systems shall conform to the requirements of the applicable provisions of NFPA and in accordance with Chapter 38 of the Uniform Building Code.
- B. The arrangements of all piping systems shall conform to the architectural requirements and field conditions, and shall be run straight and direct, forming right angles or parallel lines with building walls and other pipes, and shall be neatly spaced. Offsets will be provided where required. Standard fittings shall be used for offsets. All risers shall be erected plumb and true and shall be parallel with the walls and other pipes and shall be neatly spaced. All work shall be coordinated with all sections of Division 15, Mechanical, and Division 16, Electrical, in order to avoid interference of pipe and unnecessary cutting of floors and walls.
- C. Installation of mechanical and fire protection system within the ceiling cavity is in the following order of priority:
 - 1. Plumbing soil, waste, and roof drain lines.
 - 2. Supply, return and exhaust ductwork.
 - 3. Steam and condensate piping.
 - 4. Heating hot water and chilled water pipe.
 - 5. Lighting, bus ducts and electrical cable trays.
 - 6. Fire sprinkler mains.
 - 7. Domestic hot and cold-water mains.
 - 8. Vent piping (for waste systems).
 - 9. Fire sprinkler branch piping.
 - 10. Domestic hot and cold-water branch piping.
 - 11. Special piping systems (such as medical gas).
 - 12. Pneumatic control piping.
- D. The Fire Protection Contractor shall respect these priorities. Shop prefabrication of the sprinkler system is at the Contractor's own risk. If any field modifications are required to accommodate other trades, those modifications will be at the Contractor's own expense. All offsets of the sprinkler piping shall be provided with proper (as per NFPA) drains and air relief.

3.2 ANCHORAGE FOR TEES & BENDS (PIPING BELOW BUILDING FLOOR SLAB)

- A. All tees and bends on pipe installed underground shall be anchored. Pipe clamps and tie rods, thrust blocks, approved retainer glands, or other approved methods may be used. The type of pipe and soil conditions determine the method. Fittings shall be provided with lugs when clamps and rods are to be used. After installation, rods and clamps should be thoroughly covered with asphalt or other acceptable corrosion-resistant material. The area bearing face of concrete thrust block shall comply with UPC Section 1008.1.4, AWWA Standards and NFPA 24.

3.3 TEMPORARY FIRE PROTECTION

- A. During the construction of the building and until the permanent fire extinguishing system has been installed and is in service, temporary fire protection shall be provided as required by the Fire Marshal.

3.4 APPROVALS

- A. Upon completion of testing of this system, the Contractor shall furnish the Architect with a Certificate of Approval from the legally constituted authorities having jurisdiction.

3.5 GENERAL

- A. Sprinkler spacing in tiles at center of 2'-0" direction and at quarter points in the 4'-0" tile direction shall be acceptable.
- B. Sprinklers in finished areas are to be installed on a true axis line in both directions with a maximum deviation from the axis line of 1/2", plus or minus. Heads exceeding this, as directed by the Architect, shall be removed and reinstalled.
- C. Apply masking tape, plastic covers (available from many sprinkler manufacturers) or paper cover to ensure sprinkler's and/or cover plates do not receive field paint finish.
- D. Flush entire piping system of foreign matter prior to connection of underground piping with overhead piping system.
- E. Hydrostatically test entire system.
- F. Require test be witnessed by all authorities having jurisdiction.
- G. Coordinate the central monitoring of all systems in excess of 100 sprinklers with electrical/fire alarm contractor.
- H. All holes made by the Contractor in any wall, ceiling or floor shall be patched by the Contractor, restoring the wall, ceiling or floor to its original condition, fire resistance and integrity.
- I. Removal and repair of all finished surfaces shall be coordinated with the Architect and subject to his/her approval.
- J. Location of all equipment, controls, piping, valves, and drain shall be subject to Architect/Owner approval.
- K. Standard metal signs shall be provided in accordance with NFPA-13.
- L. All sprinklers and equipment shall be installed in accordance with manufacturer's instructions. All special tools recommended by the manufacturer shall be used.
- M. Install equipment in accordance with manufacturer's instructions.
- N. Install buried shut-off valves in valve box. Provide post indicator valves in wall or freestanding in yard where required by local codes or insurance reviewing authorities (if any).
- O. Locate fire department connection per NFPA with sufficient clearance from walls, obstructions, or adjacent siamese connectors to allow full swing of fire department wrench handle.
- P. Locate outside alarm gong/bell/horn-strobe on exterior building wall. Locate interior horn/strobe in normally occupied area.

3.6 STARTING AND COMPLETION DATES

- A. The schedule for installation of the sprinkler systems will be established at the pre-bid meeting. Coordinate schedules closely with General Contractor, Owner, and Architect.

3.7 INSPECTION

- A. The Contractor shall daily examine all areas in which the work will be performed. The Contractor shall immediately report unsatisfactory working conditions to the Owner or his/her Agent for resolution. The Contractor shall not proceed with the work until all unsatisfactory working conditions have been corrected.
- B. Owner, Architect, and all Authorities having jurisdiction shall be allowed to conduct inspections and tests as they choose. Approved sprinkler plans must be available on the project site during installation and inspection of the work.

3.8 GENERAL PREPARATION

- A. Coordinate the work of this Section with other affected work.

3.9 PIPING PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and foreign material, from inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.10 PIPING INSTALLATION

- A. Install piping in accordance with NFPA 13 for sprinkler systems, NFPA 14 for standpipe and hose systems and NFPA 24 for service mains.
- B. Route piping in orderly manner plumb and parallel to building structure. Maintain gradient.
- C. Install piping to conserve building space and not interfere with use of space and other work.
- D. Group piping whenever practical at common elevations.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- F. Slope piping and arrange systems to drain at low points.
- G. System shall be designed to allow for expansion and contraction.
- H. Prepare pipe, fittings, supports, and accessories for finished painting. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding. Refer to Division 9.
- J. Do not penetrate building structural members unless indicated in writing by Structural Engineer of record.
- K. Provide sleeves when penetrating footings, floors and/or walls. Seal pipe and sleeve penetration to achieve fire resistance equivalent to fire separation required.
- L. Die cut screw joints with full cut standard taper pipe threads with red lead and linseed oil or other non-toxic joint compound applied to male threads only.

- M. Install valves with stems upright or horizontal, not inverted. Remove protective coatings after installation.
- N. Provide gate or butterfly valves for shut-off valves or isolating service.
- O. Provide drain valves at main shut-off valves, low points of piping and apparatus.
- P. Installation or use of unidentified or foreign-made pipe, tube, or fittings is not permissible.
- Q. Where sprinkler piping is installed in finished areas, the Contractor shall install all new piping so that it is concealed above finished ceilings; provide a minimum separation of 12" between the ceiling height and the bottom of the sprinkler pipe. Pipe installed in unfinished areas may be exposed.
- R. All exposed pipes which pass through a wall, ceiling, or floor shall be provided with escutcheon plates.
- S. All piping shall be installed so as not to obstruct any portion of a window, doorway, stairway, or passageway, and shall not interfere with the operation or accessibility of any mechanical, plumbing, or electrical equipment. Run piping horizontally and at right angles to walls and ceilings or along slope of ceilings.
- T. Center sprinklers in both horizontal directions with respect to ceiling components, such as ceiling grid (in center tile of 2'-0" direction and at quarter points of 4'-0" direction), light fixtures, HVAC diffusers, speakers and detectors as required.
- U. All sprinkler piping, drain and test piping, etc. installed through exterior walls shall be galvanized and have a 4'-0" minimum length to first valve located inside insulated building envelope.
- V. All sprinkler piping must be substantially supported from building structure and only approved type hangers shall be used. Sprinkler lines under ducts shall not be supported from ductwork but shall be supported from building structure with trapeze hangers where necessary, in accordance with NFPA-13. Tapping or drilling of structural elements is not permitted. Use beam clamps or hang from top chord of joist. Do not hang from bottom chord of joist.
- W. Pendent sprinklers shall be in alignment with, and parallel to, ceiling fixtures, walls, etc.
- X. Install sprinkler piping in exposed areas as high as possible using necessary fittings and auxiliary drains to maintain maximum clear head room, and to keep space aesthetically acceptable to Architect/Owner.
- Y. Sprinklers shall be installed per the requirements of NFPA 13 with regard to ducts, obstructions, steel beams and joists, partitions, and ceiling projections. Provide additional sprinklers as required.
- Z. Provide sprinkler protection below any ducts, banks of piping, etc., meeting obstruction requirements of FM Global and NFPA 13.
- AA. The contractor should provide complete sprinkler protection before combustible contents are moved into the building.
- BB. All sprinkler piping and fittings shall be installed so that the system may be drained. System shall primarily be designed to drain through main drain at riser(s).
- CC. Minimum and maximum deflector distances shall be per FM Global and NFPA requirements. A minimum of 36-inches from deflector to top of storage shall be provided.
- DD. A minimum distance between sprinklers, as required by NFPA and the individual sprinkler U.L. listing or F.M. approval, shall be provided to avoid cold soldering of sprinklers.

- EE. Provide fire protection during construction as required by local Authorities having jurisdiction.
- FF. Where the building is to be built as a shell type building, the Contractor shall provide a complete and working sprinkler system such that the only work required by the Owner to complete the sprinkler system will be the addition of pipe drops and sprinklers in the Tenant ceiling spaces when the future ceilings are added. Outlets shall be sized adequately and bushed for future connection. The Contractor is instructed to review the Architectural and Structural Drawings and determine as to which ceilings are to be finished at this time or will be finished at a later date. The Contractor shall adjust his/her design accordingly and incorporate the addition of the future Tenant spaces in his/her design. Where the building is not to be built out as shell type areas, disregard this paragraph.

3.11 SYSTEM DRAINS

- A. Provide 2" main drain valves at system control valves and extend piping to outside building. Provide a 4'-0" minimum length of main drain piping from exterior wall penetration to angle valve.
- B. Provide all auxiliary drains where necessary, extend and terminate at a safe location.
- C. Provide 1/2" minimum pressure relief valve and drains on each riser supplying a gridded system.
- D. Pipe all drains to a location where water drained will not damage stock, equipment, vehicles, planted areas, etc., injure personnel, or patrons, or cause an unsightly wet area in front of any entrances.
- E. Plugs used for auxiliary drains shall be brass.
- F. Pressure relief and main drains shall not be interconnected.

3.12 CEILING AND WALL PLATES

- A. Install chrome wall plates wherever exposed sprinkler piping passes throughout ceiling and walls.

3.13 SLEEVES

- A. Set sleeves securely in place for all pipes passing through floor and masonry wall openings.
- B. Space between sleeve and pipe shall be filled with packing commensurate with construction. Provide chrome wall plates at each side of wall.
- C. Sleeves and seals through floors and exterior wall shall be watertight.
- D. All sleeves shall meet the requirements of all Authorities having jurisdiction and Owner.

3.14 FIRE DEPARTMENT CONNECTION

- A. Install fire department connection properly connected to piping. Provide with check valve. Where located inside the building, distance from check valve to wall mounted F.D.C. shall be 4'-0" minimum, and automatic drip connection shall be provided.
- B. Where remotely located F.D.C. shall be provided with a check valve. A concrete pad shall also be provided, and a concrete thrust block installed.
- C. Provide standard name plate marked "automatic sprinklers" or as appropriate for the system installed.

3.15 ALARM VALVES

- A. Install alarm check valve, complete with trim including paddle type water flow indicator connected to fire alarm system.
- B. Coordinate with the Fire Alarm Contractor the central monitoring of all systems in excess of 100 sprinklers have occurred per NFPA requirements.

3.16 INSPECTOR'S TEST

- A. Provide inspector's test connections as specified in NFPA-13. Discharge orifice shall have same size orifice as smallest orifice of any sprinklers installed.
- B. Provide 1" site glass where inspector's test discharge cannot be readily observed while operating valve.
- C. Pipe all inspector's test connection discharges to atmosphere at location where water drain will not damage stock, equipment, vehicles, planted areas, etc., injure personnel, or patrons, or cause an unsightly wet area in front of any entrance.
- D. All pipes and fittings downstream of inspector's test valve shall be galvanized.

3.17 WELDING AND FLAME CUTTING

- A. No welding or flame cutting by the Contractor shall be permitted on the premises.
- B. Shop welding (off-site) shall meet all NFPA-13 and related requirements. Retrieve all discs from piping prior to site delivery.

3.18 FINAL INSPECTION AND TESTS

- A. Overhead sprinkler piping: Tested for a period of two hours at a hydrostatic pressure of 200 lbs. and all piping, valves, sprinklers, etc., shall be watertight.
- B. Underground piping: Tested (by Utility Contractor) for a period of two hours at a hydrostatic pressure of 200 lbs. in accordance with NFPA Standards. Leakage shall not exceed quantities indicated. Coordinate with Utility Contractor to ensure proper testing and test schedule.
- C. Replace piping system components which do not pass the test procedures specified, and retest repaired portion(s) of the system.
- D. All underground piping shall be thoroughly flushed (by Utility Contractor) in accordance with the requirements of NFPA Standards, prior to connection to overhead piping system. The flush test must be witnessed by all Authorities having jurisdiction. A test shall be made before the trench in which pipe is laid is backfilled. Coordinate with Utility Contractor to ensure proper testing and test schedule.
- E. The Contractor shall make arrangements with all Authorities have jurisdiction for final inspection and witnessing of the final acceptance tests.
- F. If, when the Owner's consultant or any other Authorities having jurisdiction visit the job site for this purpose after being advised by the Contractor that the work is completed and ready for test, the work has not been completed, or the final acceptance tests are unsatisfactory, the Contractor shall be responsible for Consultant's extra time and expenses for reinspection and witnessing the retesting of the work. Such extra fees shall be deducted from payments by the Owner to the Contractor.

- G. Contractor shall provide at least (5) working days notice to Architect and Owner via General Contractor for all tests and field observations.
- H. Flushing of all piping shall be conducted with water flowing at a minimum velocity of 10 feet per second.

END OF SECTION

SECTION 22 01 00

GENERAL PLUMBING REQUIREMENTS

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. See General Conditions and Supplementary Conditions.
- B. The requirements listed under General Conditions and Supplementary Conditions and the General Requirements are applicable to this section and all subsequent sections of Divisions 22 and form a part of the contract.

1.2 RELATED SECTIONS

- A. See Section 22 05 21, Valves and Piping Specialties
- B. See Section 22 11 00, Building Water Supply System
- C. See Section 22 13 00, Building Soil and Waste System
- D. See Section 22 14 00, Building Roof and Area Drains

1.3 SCOPE

- A. Plumbing fixtures and equipment shall be supplied, set and connected as shown on the plans, shall meet all local and state code requirements, and as recommended by the equipment manufacturer. Fixtures and equipment shall be protected from damage during construction, and shall be thoroughly cleaned of all tape, paint and adhesive prior to final acceptance.
- B. The work included in this contract consists of furnishing all labor, materials, equipment, and tools, to completely install and place in operation the fixtures and equipment described herein.
- C. Equipment and Fixture Connections: The Contractor shall be responsible for rough-in and connection to the equipment furnished by the Owner, by others, or as under the other Sections of this specification. This shall include any equipment requiring connection to domestic hot or cold water systems, direct or indirect waste, or vent piping, as shown on the Architectural, Plumbing or Mechanical drawings. The Contractor shall coordinate his rough-in work with the Supplier of the equipment actually being furnished, and shall conform to the service requirements of furnished equipment. All final connections required by such equipment shall be made and tested by the Contractor. Carefully review the Architectural drawings for equipment and fixture locations. The rough-ins and equipment installation that applies to ADA fixtures shall comply with all local and state requirements.

1.4 CODES AND PERMITS

- A. The plumbing work shall be performed in strict accordance with the applicable provisions of the International Building Code, the International Plumbing Code, the International Plumbing Code, as adopted and interpreted by the State of Arizona, the Authority Having Jurisdiction, and the National Fire Protection Association (NFPA) Regulations, current adopted edition, regarding fire protection, plumbing systems, heating and ventilating and air conditioning systems and electrical systems. All materials and labor necessary to comply with rules, regulations and ordinances shall be provided. Where the drawings and/or specifications indicate materials or construction in excess of code requirements, the drawings and/or specifications shall govern. The Contractor shall hold and save the Architect free and harmless from liability of any nature or kind arising from his failure to comply with codes and ordinances.
- B. Permits necessary for performance of the work shall be secured and paid for by the Contractor. All utility connections, extensions, meter pits and meter sets and tap fees for water, storm sewer, sanitary sewer and natural gas shall be paid for by the Contractor.

1.5 OPERATION AND MAINTENANCE INSTRUCTIONS

- A. The Contractor shall furnish the Architect complete operating and maintenance instructions covering all plumbing equipment herein specified together with parts lists. Furnish (1) electronic copy (pdf format) or as required by the architect.
- B. See Division 1 for additional requirements concerning manuals, manual distribution, and maintenance materials.
- C. Operating and maintenance manuals as required herein shall be submitted to the Architect for review and distribution to the Owner not less than two (2) weeks prior to the date scheduled for the Contractor to provide Operating and Maintenance Instructions to the Owner as specified herein.

1.6 RECORD DRAWINGS

- A. See Division 1 for requirements associated with Project Record Drawings.

1.7 QUALIFICATIONS

- A. All mechanics shall be skilled in their respective trades.
- B. All welders shall be certified in accordance with the ASME Boiler Test Code, Section IX, latest issue.

1.8 SUBMITTALS

- A. See Division 1 for additional submission requirements.
- B. The Contractor shall submit a one (1) electronic copy (PDF format) of submittal brochures for review, or as indicated in Division 1. Brochures shall be submitted within thirty (30) days after contract award, or as indicated in Division 1.
- C. All submittals, shall be submitted at one time. Partial submittals, shall be returned to the Contractor unreviewed for completion and resubmittal.
- D. Complete data must be furnished showing quality, dimensions, complete certified characteristics of equipment, capacity, code requirements, motor drives, and certified performance curves for all fans and pumps. No equipment or materials shall be purchased prior to receiving written notification from the Architect that submittals have been reviewed and marked as follows:
 - 1. REVIEWED - NO EXCEPTIONS (Contractor Resubmittal Not Required)
Reviewed manufacturer and equipment specifications. Appears to be in conformance with design drawings/specifications.

2. REVIEWED - MAKE CORRECTIONS NOTED (Contractor Resubmittal Not Required)
Reviewed manufacturer and equipment specifications. Appears to be in conformance with design drawings/specifications. Minor adjustments required to the equipment options/accessories. Resubmittal not required if written acknowledgment is sent to the General Contractor and Architect that this items will be provided as corrected. Sub-contractor shall also provide final record submittal to the general contractor.
 3. REVIEWED - FOR RECORD ONLY (Contractor Resubmittal Not Required)
Reviewed only for coordination purpose only of another trade engineering submittals or contractor generated shop-drawings. (Often these are contractor generated installation drawings or 3rd party sealed design drawings (typically seismic engineering for MEP equipment/piping).
 4. REVISE & RESUBMIT (Contractor Resubmittal Required)
Specific manufacturer is acceptable. Equipment model, application, capacity, design parameters, code listing, testing listing is not acceptable or not provided. Resubmittal is required and all engineers' comments shall be addressed in summary memo attached with the resubmittal.
 5. REJECTED (Contractor Resubmittal Required)
Specific manufacturer is not acceptable and rejected. Manufacturer is not listed within project specs and was not prior approved within the timeframe required. Other model types/applications produced by the is manufacturer will not be accepted.
- E. Review and Approval of Submittals: Submittals will be reviewed with reasonable promptness, but only for conformance with the design concept of the Project and with the information indicated on the Drawings and stated in the Specifications. Approval of a separate item as such will not indicate approval of the assembly in which the item functions. Approval of submittals shall not relieve the Contractor of responsibility for any deviation from the requirements of the Contract Documents, nor shall approval relieve the Contractor of responsibility for the equipment fitting within the allotted space shown on the drawings with all clearances required for equipment operation, service and maintenance including a minimum of 4 feet clear in front of all electrical control equipment and panels, for errors or omissions in the submittals; or for the accuracy of dimensions and quantities, the adequacy of connections, and the proper and acceptable fitting, execution, functioning and completion of the Work.
- F. Use of accepted substitutions does not relieve the Contractor from compliance with the Contract Documents. Contractor shall bear all extra expense resulting from accepted substitutions where substitutions affect adjoining or related work required in this Division or other Divisions of this Specification.
- G. If Contractor substitutes equipment for that drawn to scale on the drawings, he shall prepare a 1/4" = 1'-0" fabrication drawing for each equipment room where a substitution is made, using dimensions of substituted equipment, to verify that equipment will fit space with adequate clearances for maintenance. This 1/4" = 1'-0" fabrication drawing shall be submitted and accepted by the Architect before construction begins.
- H. Unauthorized Substitutions: If substitute materials, equipment or systems are installed without prior approval or are installed in a manner which is not in conformance with the requirement of this Specification and for which the Contractor has not received written approval, removal of all the unauthorized materials and installation of those indicated or specified shall be provided at no extra cost to the Owner.
- J. Expense: All costs for the preparation, correction, delivery, and return of the submittals shall be borne by the Contractor.

1.9 PRIOR APPROVAL

- A. See Division 1 for substitutions and product options. In general, written requests must be received in the Architect's office ten (10) days prior to bid date to be considered. Verbal approvals will not be given.

1.10 IDENTIFICATION OF PIPING

- A. All exposed piping and piping concealed above accessible ceilings shall be labeled at 15 ft. intervals. In addition, piping concealed above rigid ceilings and inside walls and chases shall be labeled at each access door. Brady, Brimar, or accepted equivalent labels, as specified herein shall be used.

1.11 IDENTIFICATION OF VALVES

- A. Each valve shall be provided with a tag secured to the valve with metal chain or copper wire. Tag shall indicate both the service and function of each valve. Contractor shall furnish two sets of prints of drawing and showing floor plan for each floor with all valves accurately located and labeled. Drawing shall be submitted to the Architect in accordance with the requirements specified under Paragraph "Operating and Maintenance Instructions" in this Section. These drawings shall be neat and easily read. Tags shall be stamped brass (1-1/2" or 2" diameter) with 1/4" high figures.

1.12 UNDERGROUND PIPING SYSTEM IDENTIFICATION

- A. All underground facilities shall be locatable above ground without potholing. "Underground Facility" means any item of personal property that is buried or placed below ground for use in connection with the storage or conveyance of water, sewage, oil, gas or other substances, and shall include but not be limited to pipes, sewers, valves, lines, manholes, etc., and landscape irrigation systems of two inches in diameter or less. Metallic gas service lines installed on private property by the utility company are detectable without the following requirements:
 - 1. All buried nonmetallic private water lines and nonmetallic fire lines shall have a blue #18 insulated tracer wire securely attached to it at 8' o.c. and shall have 12" of tracer wire accessible above grade at the termination and be securely attached at that point.
 - 2. All buried nonmetallic private sewer lines shall have a green #18 insulated tracer wire attached to it at 8' o.c. and shall have 12" of tracer wire accessible above grade at the termination and be securely attached at that point.
 - 3. All buried nonmetallic private gas line shall have a yellow #18 insulated tracer wire attached to it at 8' o.c. and shall have 12" of tracer wire accessible above grade at the termination and securely attached at that point.
 - 4. All buried nonmetallic private landscape sprinkler lines greater than 2" in diameter shall have a purple #18 insulated tracer wire securely attached to it at 8' o.c. and shall have 12" of tracer wire accessible above grade at the termination and be securely attached at that point.
 - 5. All nonmetallic underground facilities including but not limited to empty conduit shall have a white #18 insulated tracer wire attached to it at 8' o.c. and shall have 12" of tracer wire accessible above grade at the termination and be securely attached at that point.
- B. Where an installation of any of the above referenced items connects to a public utilities service facility that does not re-emerge above grade the tracer wire shall be securely attached at the point of such transition. Where the lines extend under a building without re-emerging above grade prior to entering a building the tracer wire shall be securely attached at the point where the transition occurs.
- C. Please note that these particular requirements pertain to underground facilities on private property and will be regulated by the Building Official (Building Department). They are in addition to requirements required by the Authority Having Jurisdiction.
- D. Detectable requirements for underground facilities in rights of way will be regulated and monitored by the Authority Having Jurisdiction.

1.13 GUARANTEE-WARRANTY

- A. See Division 1 for warranties. As a minimum, the contractor shall warranty the entire plumbing system for a period of one year for parts and labor, unless specified in Division 1 to be a longer warranty period. The warranty period shall start from the date of beneficial occupancy.

PART 2 - PRODUCTS

2.1 QUALITY OF MATERIALS

- A. All equipment and materials shall be new, and shall be the standard product of manufacturers regularly engaged in the production of plumbing, equipment and shall be the manufacturer's latest design. Specific equipment, shown in schedules on drawings and specified herein, is to set forth a standard of quality and operation.
- B. Manufacturer's nameplate, name, or trademark shall be permanently fixed to all equipment and material furnished under the specification.

2.2 ELECTRICAL GROUNDING

- A. The plumbing piping system may be bonded to the electrical ground bus at the electrical service equipment, but shall not under any circumstances be used as the main grounding electrode for the electrical service.

2.3 PAINTING

- A. All finish painting of piping and conduit will be under Section 09 91 00, Painting, unless equipment is hereinafter specified to be provided with factory applied finish coats.
- B. All equipment shall be provided with factory applied finish, unless otherwise specified.

2.4 TOUCH-UP

- A. If the factory finish on any equipment is damaged in shipment or during construction of the building, the equipment shall be refinished to the satisfaction of the Architect.

2.5 ADHESIVES, SEALANTS, AND PRIMERS

- A. All adhesives and sealants used on the interior of the building (defined as inside of the weatherproofing system and applied on-site) shall comply with the requirements of the following reference standards:

1. Adhesives, Sealants, and Sealant Primers shall be under the maximum limits as set by the South Coast Air Quality Management District (SCAQMD) Rule #1168. VOC limits are listed in the table below and correspond to an effective date of July 1,2005 and rule amendment date of January 7,2005.

<u>ADHESIVES, SEALANTS SEALANTS PRIMERS</u>	<u>VOC Limit [g/L less water]</u>
PVC Welding	510
CPVC Welding	490
ABS Welding	325
Plastic Cement Welding	250
Adhesive Primer for Plastic	550
Contact Adhesive	80
Special Purpose Contact Adhesive	250
Multipurpose Construction Adhesives	70
Metal to Metal Adhesives	30

	Plastic Foams	50
	Wood	30
	Fiberglass Adhesives	80
	Sealants	420
	Sealant Primers	750
2.	Aerosol Adhesives shall be under the maximum limits as set by the Green Seal Standard for Commercial Adhesives GS-36 requirements in effect on October 19, 2000.	
	<u>AEROSOL</u>	<u>VOC Weight</u>
	<u>ADHESIVES</u>	<u>[g/L minus water]</u>
	General Purpose Mist Spray	65% VOC's by weight
	General Purpose Web Spray	55% VOC's by weight
	Special Purpose (All Types)	70% VOC's by weight

2.6 PIPING SYSTEM IDENTIFICATION

- A. Means of Identification: All piping systems shall be identified by each of the following means:
1. An identifying legend on color coded background appropriately worded to indicate the contents of the pipe. Color coded banding shall also be provided.
 2. An arrow placed to indicate the direction of flow through the pipe.
- B. Locations of Identification: The identifying legends and directional arrows described in the paragraphs preceding shall be located at the following points on each piping system:
1. Adjacent to each valve in piping system.
 2. At every point of entry and exit where piping goes through a wall.
 3. On each pipe riser and junction.
 4. Every 15 feet on continuous pipe lines exposed and concealed above accessible ceilings and on ductwork where located exposed in equipment rooms.
 5. Adjacent to all special fittings (regulating valves, etc.) in piping systems.
 6. At every access door.
- C. Directional Arrows: An arrow shall be placed to indicate the direction of flow through the pipe. The arrow shall point away from other identifying marks. This arrow shall be black (except on extremely dark-colored background, where it shall be white). The "shaft" of the arrow shall be of a size as scheduled for letters. The "head" of the arrow shall be formed by an equilateral triangle having a base equal to twice the width of the shaft. If flow can be in both directions, use a double-headed arrow with a single shaft.
- D. Piping identification shall meet the standards of the Federal Occupational Safety Health Act (OSHA) which refers to the ANSI Standard A13.1 1956 (revised 1975). The following standardized color code scheme shall be used.
- | | | |
|--------|---|--|
| Yellow | - | Hazardous Materials |
| Green | - | Liquid Materials of Inherently Low Hazard |
| Blue | - | Gaseous Materials of Inherently Low Hazard |
| Red | - | Fire Protection Materials |
- E. The size of letter and length of color field shall conform to the ANSI standard and shall be as follows:

Outside Diameter of Pipe or Covering			Length of Color Field	Size of Letters
-----	to	1-1/4"	8"	1/2"
1-1/2"	to	2"	8"	3/4"
2-1/2"	to	6"	12"	1-1/4"
8"	to	10"	24"	2-1/2"
Over	10"		32"	3-1/2"

- F. Labels shall be applied to piping and ductwork utilizing an accepted rubber cement. In addition to being held with adhesive, both ends of the label shall be held in place with colored banding tape.
- G. Labeling and banding system shall be as follows:

Service	Label	Background Color	Banding
Domestic Cold Water	C.W.	Green	2" Green
Roof Drain	R.D.	Green	4" Green
Sanitary Sewer	S.	Green	4" Green
Storm Sewer	S.S.	Green	4" Green

2.7 WALL AND CEILING ACCESS DOORS

- A. Provide all access doors required for access to valves, traps, unions, coils, cleanouts, junction boxes, expansion joints, dampers, controls, or other items for which access is required for either operation or servicing. All costs incurred through failure to perform this function as the proper sequence of this work dictates shall be borne by the Contractor. The type of access door shall be as required by the type of ceiling or wall. Verify with the architectural drawings for type required. Acoustical tile access doors shall be equivalent to Krueger Style B, Style A for acoustical plaster, Style C-CE for sidewall drywall or plaster construction. Stainless steel access doors shall be used where walls are tiled or in concession areas. Access doors in painted walls shall be primed. Verify with the architectural drawings for type of wall finish required.
- B. Access doors for plumbing devices shall not be less than 24" x 24" in size except that larger panels shall be furnished where required, and panels in tile or other similar patterned ceilings shall have dimensions corresponding to the tile or pattern module. Access doors for plumbing system shut-off valves shall not be less than 12"x12" in size, and panels in tile or other similar patterned ceilings shall have dimensions corresponding to the tile or pattern module
- C. Where access doors are installed in walls required to have a specific fire rating, the access door installed shall be fire rated access door with U.L. label, as manufactured by Milcor or accepted equivalent. Access door in 1-hour construction shall be Class C and access doors in 2-hour construction shall be Class B.
- D. Access doors in painted areas shall be primed. Access doors in tiled areas shall be stainless steel. Refer to Architectural Room Finish Schedule.

2.8 PIPING ISOLATION FROM THE SUPPORT

- A. All copper piping shall be isolated from steel supports with factory manufactured isolators. Taping as substitution for manufactured isolators will be not accepted.

2.9 PLUMBING FIXTURES AND EQUIPMENT

- A. Plumbing fixtures, circulating pumps, water heaters, and all other plumbing equipment shall be as specified in this section, on the plans, or an accepted equivalent.
- B. Final acceptance of substituted equipment is contingent upon review and acceptance by the Engineer and the satisfactory operation of the equipment when the installation is completed. Engineer acceptance shall in no way relieve the manufacturer from complying with all the provisions of the plans (including space requirements) and specifications. The substitutes of the following manufacturers of fixtures, equipment and material are acceptable to bid against the manufacturers specified.

<u>ITEM OF MATERIAL OR EQUIPMENT</u>	<u>ACCEPTABLE MANUFACTURER</u>
Plumbing Fixtures	American Standard, Kohler
Water Heaters	A.O. Smith, Bradford White, Lockinvar
Thermal Expansion Tank	Watts, Amtrol, B&G, Taco, Armstrong, Expanflex, MEPCO,
Sinks (Stainless Steel)	Just, Elkay
Access Panels	Zurn, Krueger, Mifab
Hydrants (Wall, Roof or Box)	Mifab, Woodford, Zurn, Watts, Wade
Hose Bibbs	
Floor Drains, Floor Sinks,	Mifab, JR Smith, Watts, Wade, Zurn
Roof Drains, Cleanouts,	Mifab, JR Smith, Watts, Wade, Zurn
Chair Carriers, Backwater	
Valves, Air Gap Fittings,	
Water Hammer Arrestors	
Trap Seals	Rectorseal, Studer, Oatey
Water Closet Seats	American Standard, Church, Beneke, Olsonite, Bemis, Sperzel
Flush Valves	Sloan "Royal", Delanney "Flush Boy, American Standard
Faucets	Chicago Faucets, American Standard, Moen
Stops, Traps, Grids,	McGuire, Sani-Dash, Brass Craft, Dearborne,
ADA Wrap	Engineered Brass Company (EBC), TrueBro
Backflow Preventers	Watts, Febco, Wilkins, Beeco
Electric Water Coolers	Elkay, Oasis, Haws,
Mop Basin Receptors	Fiat, Williams, Oberon

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Fixtures connecting fittings, piping and valves shall be brass or copper and, whenever exposed, shall be polished chrome-plated. Provide tight fitting wall or floor escutcheons of chrome-plated brass wherever pipes pass through floors, wall or ceilings.
- B. Equipment connecting fittings, piping and valves whenever exposed in occupied areas, except in equipment rooms, shall be chrome-plated. Painting may be used only if specifically accepted by the Architect or Engineer.
- C. All porcelain or vitreous china shall be clean, smooth and bright. All shall be warranted not to craze, discolor or scale.
- D. The Contractor shall furnish and install all required water, waste, soil and vent connections to all plumbing fixtures together with all fittings, supports, fastening devices, cocks, valves, traps, etc., leaving all in complete working order.
- E. Provide factory fabricated (or as specified) carriers for all wall hung fixtures.
- F. All automatic or self-closing valves for faucets shall be adjusted in accordance with manufacturer's instructions and supervised as necessary by equipment supplier's representative at the request of the Architect or Engineer.
- G. Owner (or others) furnished equipment shall be connected with drains, traps, hot water, cold water and other services required for optimum operation. The Contractor shall obtain information from the Owner or his appointed representative for services required, or field verify specific requirements. The Contractor shall also, prior to bidding, verify what type of connecting material and trim the Contractor shall provide for Owner, or others, furnished equipment. Contractor shall furnish and install all P-traps required and it shall be his responsibility to furnish traps compatible with the tailpieces.

- H. All fixtures shall be thoroughly cleaned to the satisfaction of the Architect before acceptance of the work.

3.2 COOPERATION WITH OTHER TRADES

- A. The Contractor shall fully examine the drawings and specifications of other trades to become familiar with all conditions affecting the work and consult and cooperate with other Divisions for determining space requirements and clearances with respect to other equipment, hangers, piping, and conduit in the building. The Architect reserves the right to determine space priority in the event of interference between piping, conduit, and equipment of various trades. Construction operations shall proceed without harm to the Owner from interference, delay, or absence of coordination.
- B. If work is installed without coordinating with other trades, and such installation interferes with their installation or proper clearances around equipment is not maintained, then make changes to correct the conditions without extra cost.
- C. The Contractor shall be responsible for the size and accuracy of all openings.

3.3 INTERRUPTING SERVICES

- A. The Contractor shall coordinate the installation of all work within the building in order to minimize interference with the operation of existing plumbing and utility systems during construction. Connections to existing systems requiring the interruption of service within the building shall be carefully coordinated with the Owner to minimize system downtimes. Requests for the interruption of existing services shall be submitted to the Architect in writing a minimum of two (2) weeks before the scheduled date. Absolutely no interruption of the existing services will be permitted without the written approval of the Architect.

3.4 DRAWINGS

- A. The plumbing drawings show the general arrangement of all piping, ductwork, equipment, etc., and shall be followed as closely as actual building construction and work of other trades will permit. The Architectural and Structural Drawings shall be considered as part of the work insofar as this information furnishes the Contractor with details relating to design and construction of the building. Architectural drawings shall take precedence over the Plumbing drawings. Because of the small scale of the Plumbing Drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The Contractor shall investigate the structural and finish conditions affecting the work and shall arrange his work accordingly, providing such fittings, valves, and accessories as may be required to meet such conditions. Should conditions necessitate a rearrangement of piping, such departures and the reasons therefor shall be submitted by the Contractor to the Architect for approval in the form of detailed drawings

3.5 FIELD MEASUREMENTS

- A. The Contractor shall verify the dimensions and conditions governing his work at the building. No extra compensation shall be claimed or allowed on account of differences between actual dimensions, including dimensions of equipment, fixtures and materials furnished, and those indicated on the drawings. Contractor shall examine adjoining work, on which his work is dependent for efficiency, and shall report any work which must be corrected. Coordination of all Plumbing work within the building will be the direct responsibility of the Contractor. Review of submittal data in accordance with paragraph "Submittals" shall in no manner relieve the Contractor of responsibility for the proper installation of the Plumbing work within the available space. No waiver of responsibility for defective work shall be claimed or allowed due to failure to report unfavorable conditions affecting his work. Installation of equipment and systems within the building space shall be carefully coordinated by the Contractor with all building trades. Installation of Plumbing equipment within the ceiling cavity shall be in the following order of priority:
 - 1. Plumbing soil, waste and roof drain lines.
 - 2. Lighting, bus duct and electrical cable trays.
 - 3. Fire sprinkler mains.

4. Domestic hot and cold water mains and branch piping.
5. Vent piping (for waste system).
6. Fire sprinkler branch piping.

3.6 HANGERS, SUPPORTS, AND INSERTS

- A. Contractor shall provide support for all equipment, piping, and ductwork to the building structure. Contractor shall furnish all necessary structures, inserts, sleeves, and hanging devices for installation of plumbing equipment and piping, etc. Contractor shall completely coordinate installation of such devices with all trades and Sub-Contractors. Contractor must further verify with the Architect that the devices and supports are adequate as intended and do not overload the building's structural components in any way.
- B. Keep piping in proper alignment and prevent transmission of thrusts and vibrations. Hangers and supports shall be capable of screw adjustment after piping is installed. Hangers shall be finely adjusted in vertical and horizontal direction under operating conditions.

3.7 PIPING SEALANT THROUGH WALLS

- A. Sealant shall be capable of sealing pipe and conduit openings to restore fire and smoke rated walls and floors to their rated integrity. Sealant shall be UL classified. All penetrations in fire and smoke rated wall or floor assemblies shall be closed with 3M, or accepted equivalent, fire barrier penetration sealing systems and installed in accordance with the terms of their U.L. listing.

3.8 PROTECTION OF MATERIALS AND EQUIPMENT

- A. The Contractor shall be responsible for the protection of all work, materials and equipment furnished and installed under this section of the specifications, whether incorporated in the building or not.
- B. The Contractor shall provide protection for all work where necessary and shall be responsible for all damage done to property, equipment and materials. Storage of materials within the building shall be accepted by the Architect prior to such storage.
- C. Pipe openings shall be closed with caps or plugs to prevent lodgement of dirt or trash during the course of installation.
- D. Plumbing fixtures shall not be used by the construction forces. At the completion of the work, fixtures, equipment and materials shall be cleaned and polished thoroughly and delivered in a condition satisfactory to the Architect.

3.9 TRENCHING AND BACKFILLING

- A. All excavation, trenching and backfilling required for the Plumbing installation shall be provided by this Contractor. Excavation and backfilling shall be done in strict accordance with Division 2, Site Work.

3.10 MANUFACTURER'S INSTRUCTIONS

- A. All equipment shall be installed in strict accordance with recommendations of the manufacturer. If such recommendations conflict with plans and specifications, the Contractor shall report such conflicts to the Architect who shall make such compromises as he deems necessary and desirable.

3.11 BASES

- A. Support equipment and other Plumbing items on curbs, legs, concrete pads, or steel framework. Provide all curbs, bases, and supports not part of the building structure, unless indicated to be part of another Division. Furnish required foundation sizes, bolts, washers, sleeves, plates, templates, etc. for Plumbing equipment provided. Equipment shall be set level.
- B. All concrete inertia bases shown and/or detailed on the Plumbing plans will be furnished and installed under this section of the specifications and shall conform to the requirements specified under the Division 3 - Concrete, portions of these specifications. Contractor shall be responsible for the accurate dimensions of all pads and bases and shall furnish and install all vibration isolators, anchor bolts, etc.
- C. Housekeeping pad foundations for floor mounted equipment will be installed under Division 3 - Concrete of the specifications. Pad foundations shall be 4" high minimum, unless otherwise indicated on the drawings. Chamfer edges shall be 1". Faces shall be free of voids and rubbed smooth with carborundum block after stripping forms. Tops shall be level. This Contractor will be responsible for location and size of housekeeping pads for all Plumbing equipment.
- D. Equipment anchor bolts shall be set in a galvanized pipe or sheet metal sleeves 1" larger than bolt diameter. Anchor bolts shall be high strength steel J shape. Anchor bolt design shall be arranged and paid for by the Contractor.
- E. Machinery bases, bed plates, sole plates, or vibration isolation units shall be carefully aligned, shimmed, leveled, then grouted in place with commercial non-shrink grout. When a flexible coupling is employed as a part of the drive train, the coupling shall be aligned before the machinery base is grouted.

3.12 EQUIPMENT FURNISHED BY OTHERS

- A. Certain items of equipment as listed on the drawings and/or specifications will be furnished by other Contractors or the Owner. This Contractor shall connect such equipment with utilities or ductwork to provide for proper operation in accordance with manufacturer's instructions.

3.13 LUBRICATION

- A. The Contractor shall provide all lubricants for the operation of all equipment until acceptance. The Contractor shall be held responsible for all damage to bearings while the equipment is being operated by him up to the date of acceptance of the equipment. The Contractor shall protect all bearings and shafts during installation.

3.14 TESTS

- A. Contractor shall make all necessary preliminary tests to ensure a tight system. Any joint found leaking under test shall be broken, cleaned, remade, and a new test applied. Requirements for testing are specified under the sections covering the various systems. The Contractor shall furnish all necessary equipment, materials, and labor to perform the required tests.

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SECTION 22 01 20

TRENCHING AND BACKFILL FOR PLUMBING SYSTEMS

PART 1 - GENERAL

1.1 REQUIREMENTS

- A. Conform with applicable provisions of the General Conditions, Supplementary Conditions and the General Requirements

1.2 SCOPE OF WORK

- A. The work in this section includes the furnishing of all labor, materials, equipment, transportation, hauling and services required in connection with the excavation, backfilling, compaction, grading and removal of earth from the site required for the installation of the plumbing work specified herein under Divisions 22 and 23.

1.3 SAFETY REGULATIONS

- A. All work performed under this Section shall conform to the requirements of the General Conditions, Supplementary Conditions and Safety Requirements for this type of work.

PART 2 - PRODUCTS

Not Applicable.

PART 3 - EXECUTION

3.1 TRENCHING AND BACKFILLING FOR UTILITIES

- A. Contractor shall verify all existing grades, inverts, utilities, obstacles and topographical conditions prior to any trenching, excavation or underground installations. In event existing conditions are such as to prevent installations in accordance with Contract Documents, Contractor shall immediately notify General Contractor for decision. General Contractor's decision will be final and binding.
- B. Contractor shall provide and maintain warning barricades, flags, torches, etc., and shall conduct his work so as to create a minimum amount of inconvenience to others, traffic, construction and the like. Temporary suspension of work does not relieve the Contractor of responsibility for the above requirements.
- C. All trenches shall be kept away from footings a minimum of 1' horizontal for each foot of depth below nearest footing or trench shall be filled with concrete to an elevation such as to establish the required one-for-one ratio of proximity.
- D. General Excavation: The Contractor shall perform all excavation of every description and of whatever substances encountered, to the depths indicated on the drawings or with the top of piping not less than 24" below finished grade]. During excavation, material shall be piled in an orderly manner a sufficient distance from the banks of the trench to avoid overloading and to prevent slides or cave-ins. All excavated material not required or suitable for backfill shall be removed and wasted as indicated on the drawings or as directed by the General Contractor. Berming and grading shall be done as may be necessary to prevent surface water from flowing into trenches or other excavations and any water accumulating therein shall be removed by pumping or by other accepted methods. Sheet piling and shoring shall be done as required for the protection of the work and for the safety of personnel.

- E. Trench Excavation: Trenches shall be of adequate width for the proper laying of the pipe, and the banks shall be as nearly vertical as practicable and safe for workmen. Bottom of trenches shall be excavated a minimum of 6 inches below bottom of pipe. Bedding material shall be sand and shall be hand tamped in 6 inch layers. Bell holes and depressions for joints shall be dug after the trench bottom has been graded, and bedded in order that the pipe rests upon the prepared bottom for as nearly its full length as practicable. Care shall be taken not to excavate below the depths indicated. Where rock excavation is required, the rock shall be excavated to a minimum overdepth of 4 inches below the trench depths indicated on the drawings or specified.
- F. All below grade sewer piping shall have installed top of pipe elevations established at fifty (50) foot intervals witnessed by the General Contractor and recorded on the as-built drawing. All below grade piping installed within the building shall be dimensionally located from column lines and recorded on the as-built drawings.
- G. The Contractor shall move trucks and equipment on prescribed roads and keep the roads free from mud, dirt and spillage.
- H. If additional material is needed for fill on the project, it shall be furnished by the Contractor.
- J. Bracing and Bulkheading: In all excavation work the Contractor shall provide necessary underpinning, bracing, or bulkheading to safeguard the work, the present structures, workmen, the public, and the property, and shall assume all responsibility in connection therewith.
- K. Backfilling: The trenches shall not be backfilled until all required pressure tests are performed and until the utilities as installed conform to the requirements specified.
- L. Fill material shall be free from trash, lumber or any type of debris which may be detrimental to producing the required density in the fill.
- M. Optimum moisture content shall be maintained within 2% of the optimum moisture content at all times (Reference Soils Report). If the material is too dry, then water shall be added until the above moisture limits are reached. If the material is too wet, then it shall be mixed and blended with dry material or dried until the above moisture limit is reached.
- N. All piping not encased in concrete shall be bedded in sand or fine gravel, without rocks or other foreign material. Bedding material shall be placed around the pipe for the full width of the trench and shall extend at least 12" completely around chilled water cast iron pipe and 6" around all other piping directly buried. The bedding material shall be distributed around pipe to assure full consolidation.
- O. In grass and planted areas, the Contractor shall backfill his excavation to 8" below finished grade. Final 8" of backfill and all surface finish work will be done under Division 31, Earthwork.
- P. The Contractor shall protect from damage all existing underground utilities and utility tunnels indicated on the Contract Drawings (or field located for the Contractor by the Owner prior to excavation operations). Any damage to such existing utilities or utility tunnels shall be repaired by the Contractor without additional costs to the Owner.
- Q. Compaction density tests of trenching backfill are to be conducted as specified in Division 2. Costs for testing will be paid Contractor. Re-tests of failed areas shall be paid for by the Contractor.

END OF SECTION

SECTION 22 05 21

VALVES AND SPECIALTIES

PART 1 - GENERAL

1.1 REQUIREMENTS

- A. Conform with applicable provisions of the General Conditions, Supplementary Conditions and General Requirements.
- B. Lead Ban: Valves used in the installation of piping systems delivering water for human consumption shall be lead free. The term lead free is defined as valves which do not contain more than 8.0% lead.

1.2 RELATED SECTIONS

- A. See Section 22 01 00 for General Plumbing Requirements.
- B. See Section 22 01 00 for Valve Identification.

1.3 SCOPE

- A. Contractor shall furnish and install all valves and accessories necessary for satisfactory operation of the systems. All valves are to be of domestic manufacture only.
- B. Contractor shall submit complete submittal data, see Section 22 01 00, for all valves including manufacturer's specifications, class type, catalog data sheets, etc..

1.4 VALVE REQUIREMENTS

- A. All valves except lubricated plug valves and butterfly valves shall be manufactured by Milwaukee, Crane, NIBCO, Kennedy, Stockham, Walworth, Powell, Watts, Hammond, Conbraco, or accepted equivalent.
- B. Butterfly valves may be substituted for gate, globe and ball valves for specified services other than domestic water, and for other services as may be approved by Engineer.
- C. All valves of the same type shall be products of a single manufacturer. Provide gate and globe valves with packing that can be replaced with the valve under full working pressure.

PART 2 - PRODUCTS

2.1 BALL VALVES

- A. Ball valves shall be cast of ASTM B-62 or B-584 bronze, 600 lb. W.O.G. 150 lb. WSP, chrome plated ball, full port, blow-out proof, threaded gland follower, reinforced teflon seats, N.A. packing, full port type. NIBCO T-585-70 threaded, S585-70 soldered, or Apollo 77-100 threaded, 77-200 soldered, or Watts B-6080 threaded, B6081 soldered.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All valves shall be installed in locations which will allow easy operation and facilitate maintenance.
- B. Valves installed on insulated services shall be provided with extensions, as required, such that operator does not interfere with insulation or insulation jacketing.

END OF SECTION

SECTION 22 07 00

PLUMBING INSULATION

PART 1 - GENERAL

1.1 REQUIREMENTS

- A. Conform with applicable provisions of the General Conditions, Supplementary Conditions and General Requirements.
- B. See Section 22 01 00 for General Plumbing Requirements.

1.2 SCOPE

- A. Domestic hot water pipe including circulating hot water, interior roof drains and horizontal piping, domestic cold water piping.
- B. Equipment covering, including storage tanks.

1.3 TESTING

- A. All piping shall be tested and accepted before any insulation is applied.

1.4 FITTINGS

- A. All fittings except as otherwise specified, shall be insulated with the same material and thickness as specified for the pipe.
- B. Unions, flanges and valves on hot water, will not require insulation.

1.5 QUALITY ASSURANCE

- A. Qualifications
 - 1. Manufacturer - Company specializing in manufacturing products specified with a minimum 5 years documented experience.
 - 2. Installer - Company specializing in performing the work of this section with a minimum 5 years documented experience.

PART 2 - PRODUCTS

2.1 INSULATION

- A. Insulation shall be as manufactured by Owens-Corning Fiberglass, Gustin-Bacon, Johns-Manville, or Armstrong, Manson, or accepted equivalent, and shall be equivalent to that specified below.
- B. Insulation and all materials on the interior and exterior surfaces of pipes, and equipment shall have a composite fire and smoke hazard rating not exceeding: Flame spread - 25; fuel contribution - 50; smoke developed - 50, as determined in accordance with ASTM Standard E-84. Linings in ducts, plenums, and equipment shall meet the Erosion Test Method described in Underwriter's Laboratory Publication No. 181. Insulation shall have a "k" factor of 0.23 at 75 deg. F mean temperature unless otherwise indicated. All insulation materials used for valves and fittings shall have the same ratings as the insulation. Information must be submitted to Architect by means of manufacturer's literature showing that the materials conform to above specification without exception.

2.2 FITTINGS

- A. Fittings, where required to be insulated, shall be covered with fitting mastic reinforced with fiberglass fitting tape and finished to a smooth surface or prefabricated or molded insulation may be used on all fittings where applicable, providing materials meet specified fire and smoke hazard ratings.

2.3 PVC FITTING COVERS

- A. PVC fitting covers may be used for all valves and fittings requiring insulation provided the materials used meet the fire and smoke hazard ratings specified above, and only where the valves and fittings have been wrapped with fiberglass blanket insulation of the same thickness of insulation used on the pipe. Fiberglass blanket shall be held in place with soft copper wire and adhesive applied to the valve or fitting.

PART 3 - EXECUTION

3.1 DOMESTIC COLD WATER PIPING

- A. Domestic cold water piping shall be insulated with 1-inch thick Fiberglass one-piece preformed pipe insulation with all purpose (ASJ) fire retardant jacket bonded to aluminized film. Fittings shall be furnished with fittings mastic reinforced with Fiberglass fitting tape and finished to a smooth surface. Hangers shall be installed under the insulation.

3.2 STORM DRAIN PIPING

- A. All above grade PVC storm drain piping shall be insulated with 1-inch thick Fiberglass one-piece preformed pipe insulation with all purpose (ASJ) fire retardant jacket bonded to aluminized film. Fittings shall be furnished with fittings mastic reinforced with Fiberglass fitting tape and finished to a smooth surface. Hangers shall be installed under the insulation.

3.3 DOMESTIC HOT WATER PIPING:

- A. Domestic hot water piping, including recirculating piping, shall be insulated with a minimum of 1-inch thick fiberglass one-piece preformed pipe insulation with all purpose (ASJ) fire retardant jacket. Pursuant with IECC Table 403.11.3, pipe sizes less than and equal to 1-1/4", shall be provided with 1-inch thick insulation. Pipe sizes larger than 1-1/4" shall be provided with 1-1/2-inch thick insulation. Fittings shall be finished with fittings mastic reinforced with fiberglass fitting tape and finished to a smooth surface. Hangers shall be installed under the insulation.

3.4 INSULATION AT VALVES

- A. The termination of all insulation on pipes at valve connections or unions, etc., shall be beveled and finished same as called for on all fittings.

3.5 APPLICATION

- A. No pipe insulation shall be applied until piping has been pressure tested and accepted. No duct insulation shall be applied until the ducts have been inspected and accepted. All insulation shall be applied in strict accordance with the manufacturer's recommendations.

3.6 PIPE HANGERS

- A. Hangers for copper tubing shall be insulated from the tubing or hangers shall be of copper construction.

END OF SECTION

SECTION 22 11 00
BUILDING WATER SUPPLY SYSTEM

PART 1 - GENERAL

1.1 REQUIREMENTS

- A. Conform with the applicable provisions of the General Conditions, Special Conditions, and the General Requirements.

1.2 RELATED SECTIONS

- A. See Section 22 01 00, General Plumbing Requirements.
- B. See Section 22 05 21, Valves & Specialties
- C. See Section 22 13 00, Building Soil and Waste System

1.3 SCOPE

- A. A complete domestic cold water and make-up water system including associated miscellaneous items. This section is limited to the items referenced herewith within the building envelope and out to a point 5'-0" outside the building, unless noted otherwise on the drawings.
- B. Furnish and install all concrete, grout, and other required materials, to fill all blockouts and/or sleeves left open for the Contractor's convenience, or for the installation of this work.
- C. The work included in this contract consists of furnishing all labor, materials, equipment, tools and services; and includes all costs of permits and all costs whatsoever which may be required to completely install and place in operation the systems herein described.
- D. Equipment and Fixture Connections: The Contractor shall be responsible for rough-in and connection to equipment furnished by the Owner, by others, or as under the EQUIPMENT Sections of this specification. This shall include any equipment requiring connection, to domestic hot or cold water systems, direct or indirect waste, or vent piping as shown on the Architectural, Plumbing or Mechanical Drawings. The Contractor shall coordinate his rough-in work with the supplier of the equipment actually being furnished and shall conform to the service requirements of the furnished equipment. All final connections required by such equipment shall be made and tested by the Contractor. Carefully review the Architectural drawings for all of the equipment and fixture locations.

1.4 QUALITY ASSURANCE

- A. All pipe and fittings shall be of domestic (U.S.) origin.

PART 2 - PRODUCTS

2.1 PIPING

- A. Domestic water system piping below grade or slab on grade shall be Type "K" soft temper copper tubing.
- B. Domestic water system piping above slab on grade shall be Type "L" hard drawn copper tubing.

2.2 FITTINGS

- A. Fittings for copper piping below grade with brazed joints shall be wrought copper (the same thickness as the piping) for solder joint-pressure type.
- B. Fittings for copper piping above grade shall be wrought copper or cast red brass for solder joint-pressure type.

2.3 JOINTS

- A. Joints for copper piping systems 2" and smaller shall be made using 95-5 Tin-Antimony or approved lead free solder. (No 50/50 or any lead containing solder will be permitted on domestic water piping, hot or cold.)
- B. Joints for copper piping systems 2-1/2" and larger above grade slab and all sizes below grade slab shall be made using Sil-Fos, Easy Flow, or Phos Copper brazing rods with a melting temperature above 1000 deg. F.

2.4 PROTECTION OF PIPING

- A. Copper piping installed below grade or slab on grade shall be protected against corrosion as follows:
 - 1. One and one half inch (1-1/2") or smaller shall be installed in polyethylene protective conduit terminated not less than 6" above finished floor slab and a minimum 36" from the building outside wall.
 - 2. Two inch (2") or larger shall be protected by a double wrapping of X-Tru-Coat, or Scotch Wrap, or by a double coat of bituminous paint. Termination of coating shall be the same as described for 1-1/2" or small pipes.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING

- A. All water piping shall be run free from traps and arranged so that all parts of the system can be drained. Provide accessible 3/4" full port ball valves with hose ends where required for this purpose. Provide expansion loops or connections throughout the system to allow for adequate horizontal and vertical expansion and contraction, and for building setting at the point of water main entry into the building. All pipe size changes shall be made with reducing fittings or bell reducers or increasers where any change in the pipe sizes occur. No bushing of any nature shall be allowed in piping.
- B. Care shall be taken to avoid mechanical ductwork, electrical equipment and air handling equipment above ceiling. The Contractor shall be responsible for coordinating routing of piping with ceiling Contractor and sheet metal Contractor. Relocation of piping required from poor coordination by the Contractor shall be at his own expense.
- C. No water piping shall be located in outside walls unless shown, and then piping is to be insulated and located as close as possible to inside of wall cavity with additional insulation between piping and exterior of wall.

- D. Written prior approval required for all proposed substitutions of equipment and materials, 10 days prior to bid date of project.
- E. All piping shall be concealed where possible. All exposed piping where concealment is not possible, or in equipment room, shall be painted.
- F. All trenching and backfill for piping shall be the responsibility of the Contractor.
- G. Any changes to the plans shall be accepted by Architect/Engineer. Contractor shall submit in writing any proposed changes for approval and receive approval prior to making such changes.
- H. All pipe through footings below floor slab shall have cast iron soil pipe sleeve (minimum two pipe sizes larger) which extends full width of footings.
- J. Pipe openings shall be closed with caps or plugs to prevent lodgement of dirt or trash during the course of installation.

3.2 VALVE CONTROL

- A. Control valves shall be installed where shown on the plans and/or as directed, wherever necessary for controlling the several sections of the domestic water system. All valves shall have adjacent unions (except on copper piping.) Valves shall be provided on all inlet connections to all kinds of apparatus, all risers and all groups of fixtures. Groups of fixtures shall be arranged to have their group valves in one location. Access shall be provided to all concealed valves by means of access doors furnished by the Contractor and installed by the Contractor. The Contractor shall coordinate the location of valves with architectural features of the building in order that the access doors will be located symmetrically with the other features.

3.3 VALVES

- A. All ball valves shall be designed for repacking under pressure when fully opened and shall be equipped with packing suitable for the intended service. Gate valves shall be installed in the horizontal position, other valves in the vertical position and, whenever possible, shall be grouped.
- B. Valves shall be full port and manufactured by Jenkins, Nibco, Crane, Milwaukee, Walworth, Norris, Stockham, Kennedy, Lunkeneimer, Nordstrom, Dezurick or Grinnell and shall be as specified in Section 23 05 23.

3.4 UNIONS AND FLANGES

- A. Unions and flanges shall be installed at all points necessary to permit easy removal of valves and equipment without injury to other parts of the system. Unions in screwed piping shall be Grinnell Fig. 459. Unions in copper piping shall be Grinnell Fig. 9102 in wrought copper, Fig. 9730 in cast brass. Fabricate flanged headers to make it possible to remove tube bundles, or similar items, without having to disconnect any major portions of piping.
- B. All connections between ferrous and non-ferrous piping or equipment shall be made with dielectric unions. Dielectric material shall not be paper.

3.5 HYDRANTS AND HOSE BIBBS

- A. Hose bibbs, wall and box hydrants shall be the type as specified in the Plumbing fixtures, trim and equipment specifications as shown on the drawings. Deliver all hydrant keys and handles to the Owner's representative.
- B. All hose bibbs and hydrants shall have a vacuum breaker on the outlet. Install a shutoff valve before hose bibb/wall hydrant/ground hydrant for maintenance purposes.

3.6 ACCESS DOORS

- A. All concealed valves, controls, etc., shall be provided with access doors. Type of doors as specified in the Specification Section 22 01 00.

3.7 BACKFLOW PROTECTION

- A. Protection: All plumbing fixtures, faucets with hose connections, and all other equipment having plumbing connections shall have their water supplies protected against back-siphonage, as shown on the drawings, or as required by the plumbing code or local health authorities.
- B. Testing: Arrange for testing and approval of all backflow devices as required by the IPC Section 608, local health authorities and the Engineer.

3.8 TESTS

- A. Test water pipe systems at 100 psi minimum in the presence of the General Contractor or Architect and prove water to be tight. Use higher pressure when indicated, or where required for building height or by Authority Having Jurisdiction.
- B. Tests: All water piping, hot and cold, shall be made tight under a hydrostatic test pressure of 150 pounds per square inch and maintained without pressure loss and visible leakage for a minimum of four (4) hours. No caulking to joints will be permitted. Any joint found to leak under this test shall be broken, remade, and a new test applied. Certify to the Architect that the tests have been completed.

3.9 STERILIZATION

- A. On the building side of the water supply piping, provide a 3/4 inch connection through which chlorine shall be introduced into the building water piping systems to sterilize those systems thoroughly.
- B. After completion of testing, the entire cold and hot water piping systems, with attached equipment, shall be thoroughly sterilized with a solution containing not less than 50 parts per million of available chlorine, or calcium hypochlorite or chlorinated lime, and shall be pumped into the system through the connection described above. The sterilization solution shall be allowed to remain in the system for a period of twenty-four (24) hours during which time, all valves and faucets shall be opened and closed several times. After sterilization, the solution shall be flushed from the system with clean water until the residual chlorine content is not greater than 0.2 parts per million.
- C. The sterilization process shall be conducted as described by the State of Arizona, Department of Public Health, and upon completion of the process, the Testing Agency shall test and certify the cleanliness of the water piping system. The Contractor shall pay all costs and charges incidental to this test.

END OF SECTION

SECTION 22 11 23

BUILDING NATURAL GAS SUPPLY SYSTEM

PART 1 - GENERAL

1.1 REQUIREMENTS

- A. Conform with applicable provisions of the General Conditions, the Supplementary Conditions and General Requirements.

1.2 RELATED SECTIONS

- A. See Section 22 01 00, General Plumbing Requirements
- B. See Section 22 20 00, Pipe and Pipe Fittings
- C. See Section 22 70 00, Outside Utilities

1.3 SCOPE

- A. The Contractor shall furnish and install a complete natural gas piping system as shown on the drawings.
- B. The system shall include connection to main in the street and a service line up to the building, including a gas meter and pressure reducing equipment (or station) with all necessary components as required by the local Gas Company.]
- C. The contractor shall furnish and install a complete gas piping system as shown on the drawings.
- D. The system shall include a service line up to the building and a pressure reducing equipment (meter) with all necessary components as required by the local Gas Company.
- E. The work included in this contract consists of furnishing all labor, materials, equipment, tools and services, and includes all costs of permits and all costs whatsoever which may be required to completely install and place in operation the systems described herein.
- F. Equipment Connections: The Contractor shall be responsible for rough-in and connection of the equipment furnished by the Owner, or by others, or as under the Equipment Section of this specifications. This shall include any equipment requiring connection to gas piping systems as shown on the Plumbing, HVAC or Architectural drawings. The Contractor shall coordinate his rough-in work with the supplier of the equipment actually being furnished and shall conform to the service requirements of the furnished equipment. This shall include but is not limited to unions and quick connects. All final connections required by such equipment shall be made and tested by the Contractor. Carefully review the Architectural drawings for all of the equipment locations.
- G. Furnish and install all concrete, grout, and other required materials to fill all blockouts and/or sleeves left open for the Contractor's convenience, or for the installation of this work.
- H. The gas system shall be installed only by a properly licensed firm with a qualified and experienced gas piping crew.
- I. Provide cathodic protection for underground gas piping as required.

1.4 QUALITY ASSURANCE

- A. All pipe and fittings shall be of domestic (U.S.) origin.

PART 2 PRODUCTS

2.1 PIPING

- A. Piping below grade outside of the building shall be Polyethylene Plastic Pipe (PE), conforming to ASTM D 2513 and shall be marked "Gas" and "ASTM D 2513". Contractor shall provide a yellow insulated tracer wire or other approved conductor adjacent to underground PE piping and terminate above ground at each end of non-metallic piping. The tracer wire shall not be less than 18 AWG and the insulation type shall be suitable for direct bury.
- B. Piping above grade and inside of the building shall be Schedule 40 black steel pipe, conforming to ASTM Designation A-53.
- C. Anode less gas risers shall consist of factory assembled, polyethylene encased steel pipe sweeps and shall be leaked tested by the manufacturer.

2.2 FITTINGS

- A. Below grade joints for PE piping below grade shall be heat-fusion and in accordance with qualified procedures that have been established and proven to produce gas-tight joints at least as strong as the pipe or tubing joined. Joints shall be made with the joining method recommended by the pipe manufacturer and all heat-fusion fittings shall be marked "ASTM D 2513". Where compression-type mechanical joints are used, the gasket material in the fitting shall be compatible with the plastic piping and with the gas distributed. An internal tubular rigid stiffener shall be used in conjunction with the fitting.
- B. Above grade piping 1-1/2" and smaller may have screwed fittings, except in the return air space where all gas piping shall be welded. Piping 2" and larger shall be welded..

2.3 GAS COCKS

- A. 1-1/2" and smaller shall be manufactured by Milwaukee BB2-100.
- B. Gas cocks shall be manufactured by Crane Co. All gas cocks 2" and larger shall be lubricated plug valves manufactured by Resun, Nordstrom, Rockwel, or Walworth.

2.4 CATHODIC PROTECTION

- A. The contractor shall include the services of a company that specializes in designing and installing cathodic protection. The company shall have an engineer registered in the State of Arizona that shall design the cathodic protection system. Upon completion of the installation, the engineer shall certify the acceptability of the installation to the Architect. The installation shall conform to the requirements of Parts 191 and 192 of Code of Federal Regulations Title 49.

PART 3 EXECUTION

3.1 INSTALLATION OF PIPING

- A. All piping shall be run straight without sags or traps and shall be so pitched as to drain back to the risers. A drop pocket consisting of a nipple and a cap shall be screwed into the bottom of each main riser and as shown on the drawings.
- B. Installation of all gas piping in the building shall comply with the latest applicable addition of the UPC, standards set by NFPA 54, National Fuel Gas Code, and other applicable standards, unless otherwise shown on the drawings, or as specified in these specifications.

- C. No gas valve shall be installed in the return air ceiling space. Piping in the return air ceiling space shall be welded and encased in steel protective conduit (minimum Schedule 20 pipe), vented to the outside. Protective conduit may be eliminated if specifically approved by the local governing authority and written authorization is obtained by Contractor and submitted to the engineer for approval. Gas piping installed below sidewalks or paved areas adjacent to the building shall be installed in protective conduit (Schedule 40 PVC pipe) vented to the outside and terminated not less than 12" above the finished grade and 5' beyond the end of the pavement or sidewalk.
- D. All piping and fittings below grade and up to 6" above grade outside of the building structure shall be protected against corrosion by a wrapping (factory or job-site) applied in accordance with the standards of the gas industry (X-Tru-Coat or Scotch Wrap).
- E. Provide expansion loops throughout the system to allow for adequate horizontal and vertical expansion and contraction.
- F. Unions and quick disconnects, or companion flanges shall be provided for easy removal of all equipment.
- G. All gas lines exposed to weather (above roof, etc.) shall be treated with two coats of asphalt paint. All exposed lines inside building shall be painted to match surroundings or as directed by the Architect.
- H. Welding of pipes shall comply with the Standard Practice of the American Welding Society using standard welding fittings. No notching or mitering of pipe will be accepted. Weld-o-lets may be used for the tee connection up to one half of the line size and not to exceed 4" in size.
- J. No bending of pipe will be permitted.

3.2 TESTS

- A. Gas piping shall be tested with air pressure in accordance with the latest edition of the International Fuel Gas Code, or as directed the State Inspector.

END OF SECTION

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SECTION 22 13 00

BUILDING SOIL AND WASTE SYSTEM

PART 1 - GENERAL

1.1 REQUIREMENTS

- A. Conform with applicable provisions of the General Conditions, Special Conditions, and General Requirements.

1.2 RELATED SECTIONS

- A. See Section 22 01 00, General Plumbing Requirements
- B. See Section 22 05 21, Valves and Piping Specialties
- C. See Section 22 11 00, Building Water Supply System
- D. See Section 22 14 00 Building Roof and Area Drains

1.3 SCOPE

- A. The building sanitary drainage system limited to a point 5'-0" outside of the building (unless noted otherwise) shall be installed, as shown on the Plans, complete with all fixtures, drains, traps and required connections. All fixtures and drains shall be properly trapped and vented as required by the applicable plumbing code.
- B. Furnish and install all concrete, grout, and other required materials to fill all blockouts and/or sleeves left open for the Contractor's convenience, or for the installation of this work.
- C. The work included in this contract consists of furnishing all labor, materials, equipment, tools and services, and includes all costs of permits and all costs whatsoever which may be required to completely install and place in operation the systems herein described.
- D. Equipment and Fixture Connections: The Contractor shall be responsible for rough-in and connection to equipment furnished by the Owner, by others, or as under Section 22 01 00 of this specifications. This shall include any equipment requiring connection to domestic hot or cold water systems, direct or indirect waste, or vent piping as shown on the Architectural Plumbing or Mechanical drawings. The Contractor shall coordinate his rough-in work with the Supplier of the equipment actually being furnished and shall conform to the service requirements of the furnished equipment. All final connections required by such equipment shall be made and tested by the Contractor. Carefully review the Architectural drawings for all of the equipment and fixture locations.

1.4 QUALITY ASSURANCE

- A. All pipe and fittings shall be of domestic (U.S.) origin.

PART 2 - PRODUCTS

2.1 PIPING

- A. Soil, waste, and vent piping below slab on grade shall be hub and spigot cast iron soil pipe and fittings conforming to the latest issue of ASTM A74, ANSI A112.5.1 and Federal specification WW-P-401E or hubless cast iron soil pipe and fittings conforming to ASTM Standard A-888 and/or CISPI Standard 301 (latest revision) and Federal Specifications WW-P-401E(Type III).
- B. Soil, waste, and vent piping above grade shall be hubless cast iron soil pipe and fittings conforming to ASTM Standard A-888 and/or CISPI Standard 301 (latest revision) and Federal Specifications WW-P-401E(Type III).
- C. All waste and vent piping shall have epoxy coating and shall have the coating applications third party certified to EN-877.

2.2 FITTINGS

- A. Fittings for cast iron sanitary soil, waste and vent piping system shall be service weight cast iron drainage pattern conforming to CISPI Standard 301-95, coated for underground installation. Threaded cast iron drainage pattern fittings to conform to ANSI Standard B-16.4. Fittings shall be provided to match the required piping system.
- B. Tapped sanitary tees and crosses will be permitted only for fixtures connections. Crosses shall have the barrel of the fitting two pipe sizes larger than the largest branch inlet.
- C. Vent fittings installed below slab on grade shall have drainage pattern.
- D. Waste and vent fittings shall have epoxy coating and have coating applications third party certified to EN-877.

2.3 JOINTS

- A. Joints on cast iron soil waste and vent system below grade slab shall be gaskets conforming strictly to ASTM Standard C564, latest issue or no-hub sealing sleeves conforming strictly to ASTM Standard C564, CISPI Standard 310 (latest revision), ASTM C1277, and Federal Specifications WW-P-401.
- B. Joints on cast iron soil waste and vent system above grade slab shall be no-hub sealing sleeves conforming strictly to ASTM Standard C564, CISPI Standard 310 (latest revision), ASTM C1277, and Federal Specifications WW-P-401.

2.4 EQUIPMENT DRAINS

- A. The Contractor shall extend drain lines from all equipment requiring drainage, relief valves, reduced pressure backflow preventers, and drain pans to the nearest floor drain or floor sink, or as shown on the drawings, or as directed by the Engineer.
- B. Relief valve drain lines shall be equal in size to the valve outlet port and shall be sloped away from the relief valve.
- C. Equipment drain lines shall be Type "M" copper tubing with solder fittings.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING

- A. The Contractor shall promptly install sewer, drains, and piping after excavating, chasing or cutting for same as has been done, so as to keep the openings for such piping open as short a time as possible. No piping shall, however, be permanently closed up, furred in or covered before the testing and examination of same by the authorities having jurisdiction.
- B. All piping shall be run in the most direct manner. Horizontal pipe shall have a grade of one-quarter (1/4) inch per foot wherever possible and not less, in any case, than one-eighth (1/8) inch per foot (1/8" per foot allowable only for pipes 4" in diameter and larger). Sewer mains larger than or equal to 8" in diameter may be run at 1/16" per foot slope if noted on plans to meet the civil confections. All offsets shall be 45-deg. or less.
- C. Cleanouts shall be provided at:
 - 1. The bottom of each soil or waste stack;
 - 2. On horizontal drain lines below grade longer than 5';
 - 3. On each plumbing fixture or group of fixtures;
 - 4. On horizontal vent lines if rising at an angle less than forty-five (45) degrees from the horizontal up to a point at least six inches (6") above the flood rim of the fixture served by the vent;
 - 5. Where the horizontal building drain has a change of direction greater than 45 degrees, a cleanout shall be installed at the change of direction. If more than one change of horizontal direction greater than 45 degrees occurs within 40 feet of *developed length* of piping, the cleanout installed for the first change of direction shall serve as the cleanout for all change in direction within that 40 feet of *developed length* of piping.
 - 6. On interior and exterior horizontal runs at intervals not exceeding 100'. The interval length shall be measured from the cleanout opening along the developed length of pipe to the next drainage fitting providing access for cleaning.
 - 7. Two-way cleanouts outside of the building shall be installed as shown on the drawings, or as a substitution for an upper terminal cleanout.
 - 8. All interior cleanouts shall be the same size as the pipe served up to 4" size and 4" for all larger lines. Exterior cleanouts shall consist of a concrete encased wye in the line with sewer piping extending upward therefrom and terminating in a concrete slab at grade. A cleanout casting as specified shall be set on this slab in such a manner as to be flush with the finished grade. All exterior cleanouts shall be the same size as the sewer up to 6" size and shall be 6" for all larger lines. See Cleanout details and Specifications.
- D. Fixture vent piping shall be kept above the fixtures in such a manner as to preclude the use of the vents as waste, if the waste pipes later become obstructed. All vent pipes shall be properly graded without drops or sags, and so connected as to drip back to waste pipes by gravity. Whenever practical, or as shown on the drawings, two or more vents shall be connected together at a point not less than 6" above flood rim of fixtures served by the vent, and extended as one vent through the roof. Vent piping installed below grade slab shall be not less than 2" diameter.

3.2 FLASHINGS

- A. Flash vent piping through roof (V.T.R.) with lead flashing, weight of not less than four (4) pounds per square foot, extending at least 14" in all directions under roofing and 12" up around the vent pipe. Cap flash pipe and turn down inside 1" approximately. Install all vent pipes extending through roof prior to roof installation. Flashing shall be two-piece type, base and cap flashing. Prior to the roofing installation, furnish base flashing pieces to the Contractor for installation by the Contractor. The Contractor shall install cap flashing.
- B. Floor drains and floor sinks (which are specified with a flashing clamp) and all job-site built shower pans shall be flashed with 0.40" thick non-plasticized chlorinated polyethylene sheet, Chloraloy 240, as manufactured by Noble Company, or accepted equivalent. Each floor drain and floor sink flashing shall be minimum 36" x 36" square and shall be terminated (if applicable, in corners and against walls) not less than 6" above finish floor.

3.3 TESTS

- A. The Plumbing Contractor shall be responsible for contacting the Authority Having Jurisdiction prior to the start of construction to verify the testing requirements.
- B. The Testing Agency shall certify in writing that all tests were satisfactorily completed before piping was concealed, and shall submit the certification to the Architect for his records, and for transmittal to the Owner.

END OF SECTION

SECTION 22 14 00

BUILDING ROOF DRAINAGE SYSTEM

PART 1 - GENERAL

1.1 REQUIREMENTS

- A. Conform with the applicable provisions of the General Conditions, Special Conditions, and the General Requirements.

1.2 RELATED SECTIONS

- A. 22 01 00 General Plumbing Requirements
- B. See Division 7, Thermal & Moisture Protection.

1.3 SCOPE

- A. A complete storm water drainage piping system shall be installed as shown on the plans and shall be limited to a point 5'-0" outside of the building, unless otherwise noted.
- B. Complete overflow roof drainage system as shown on the plans.
- C. Roof and overflow drains shall be furnished and piped under Division 22 but installed under Division 7 of the Specifications.

1.4 QUALITY ASSURANCE

- A. All pipe and fittings shall be of domestic (U.S.) origin.

PART 2 - PRODUCTS

2.1 PIPING

- A. Roof drain piping below slab on grade shall be hub and spigot cast iron soil pipe and fittings conforming to the latest issue of ASTM A74, ANSI A112.5.1 and federal specifications WW-P-401E or hubless cast iron soil pipe and fittings conforming to ASTM standard A-88 and/or CISPI standard 301 (latest edition) and federal specifications WW-P-401 (Type III) or polyvinylchloride (PVC) pipe, Schedule 40, conforming to ASTM D2665, D3311, and D1784.
- B. Roof drain piping above grade shall be polyvinylchloride (PVC), Schedule 40, conforming to ASTM D2665, D3311, D1784.1. Installation of PVC Schedule 40 shall comply with all current codes, local amendments and per IAPMO/ASPE installation standards. Allow for expansion every 30 feet minimum. Install offset from first elbow on the horizontal branch directly under the roof drain receiver, then another expansion offset a minimum of every 30 feet along the horizontal run. Contractor to coordinate locations of the expansion joints.

2.2 FITTINGS

- A. FITTINGS FOR CAST IRON PIPE SHALL BE SERVICE WEIGHT CAST IRON DRAINAGE PATTERN, CONFORMING TO CISPI STANDARD 301-95 AND ASTM A-888.
- B. Fittings for PVC piping system shall be Schedule 40 drainage pattern, solvent cement type conforming to ASTM B-2855 or elastomeric seal type conforming to ASTM D-3212.

2.3 JOINTS

- A. Joints on cast iron roof drain systems below slab or grade shall be gaskets conforming strictly to ASTM STANDARD C564, latest issue no hub couplings above and below ground. They shall be mulitiply band type (4 bands = 1-1/2" thru 4") and (6 bands = 5" thru 15"). Contractor to follow the manufacturers recommendation on PSI of torque required to secure couplings. No-hub sealing sleeves confirming strictly tp ASTM STANDARD C564, CISPI STANDARD 310 (latest revision), ASTM C1277, AND Federal Specifications WW-P-401. Couplings shall be manufactured by mission "heavy weight", or husky "2000".
- B. Joints for PVC piping system shall be either solvent cement type conforming to ASTM D-2855 or elastomeric seal type conforming to ASTM D-3212, except all joints above grade shall be solvent cement.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING

- A. All piping shall be run in the most direct manner. Horizontal pipes shall have a grade of 1/4" per foot wherever possible and not less, in any case, than 1/8" per foot, unless shown otherwise on the plans. All offsets shall be 45 degrees or less.
- B. Size reduction of vertical R.D. leaders is not permitted.

3.2 ROOF DRAINS

- A. All roof drains will be furnished and installed by the Contractor with all accessories required for the particular construction in which they are to be mounted, and shall be as manufactured by Smith, Mifab, Zurn or Wade.
- B. Roof drains shall be flashed with lead flashing, weight of not less than four (4) pounds per square foot or with laminated flashing, Nobleflex (0.40" thick non-plasticized chlorinated polyethylene sheet adhered with asphalt-saturated roofing felt), as manufactured by the Noble Company, or an accepted equivalent. Each flashing shall be a minimum of 36" x 36" square.

3.3 TESTS

- A. The Plumbing Contractor shall be responsible for contacting the Authority Having Jurisdiction prior to the start of construction to verify the testing requirements.
- B. The Testing Agency shall certify in writing that all tests were satisfactorily completed before piping was concealed, and shall submit the certification to the Architect for his records, and for transmittal to the Owner.
- C. Piping for pumped roof and area drainage systems shall be pressure tested as specified in Section 22 11 00 for water systems as a minimum pressure equal to the system working pressure.

END OF SECTION

SECTION 23 01 00

GENERAL MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. See General Conditions and Supplementary Conditions.
- B. The requirements listed under General Conditions and Supplementary Conditions and the General Requirements are applicable to this section and all subsequent sections of Divisions 21, 22, 23, and 25 and form a part of the contract.
- C. See Division 2, Site Work for Trenching, Backfilling and Compaction requirements.

1.2 CODES AND PERMITS

- A. The mechanical work shall be performed in strict accordance with the applicable provisions of the International Building Code, the International Plumbing Code, the International Mechanical Code, as adopted and interpreted by the State of Arizona, the Authority Having Jurisdiction, and the National Fire Protection Association (NFPA) Regulations, current adopted edition, regarding fire protection, plumbing systems, heating and ventilating and air conditioning systems and electrical systems. All materials and labor necessary to comply with rules, regulations and ordinances shall be provided. Where the drawings and/or specifications indicate materials or construction in excess of code requirements, the drawings and/or specifications shall govern. The Contractor shall hold and save the Architect free and harmless from liability of any nature or kind arising from his failure to comply with codes and ordinances.
- B. Permits necessary for performance of the work shall be secured and paid for by the Contractor. All utility connections, extensions, meter pits and meter sets and tap fees for water, storm sewer, sanitary sewer and natural gas shall be paid for by the Contractor.

1.3 OPERATION AND MAINTENANCE INSTRUCTIONS

- A. The Contractor shall furnish the Architect complete operating and maintenance instructions covering all units of mechanical equipment herein specified together with parts lists. Furnish four (4) copies of all the literature; each shall be suitably bound in loose leaf book form.
- B. A lubrication list shall be provided indicating all types of lubricants to be used for each piece of equipment and the recommended frequency of lubrication.
- C. Complete temperature control diagrams including control descriptions, system sequence of operation and operating instructions shall also be provided, in duplicate suitably bound in loose leaf book form.
- D. See Division 1 for additional requirements concerning manuals, manual distribution, and maintenance materials.
- E. Operating and maintenance manuals as required herein shall be submitted to the Architect for review and distribution to the Owner not less than two (2) weeks prior to the date scheduled for the Contractor to provide Operating and Maintenance Instructions to the Owner as specified herein.
- F. Upon completion of all work and all tests, Contractor shall furnish the necessary skilled labor and helpers for operating the mechanical systems and equipment for a period of five (5) days of eight (8) hours each. During this period, the Contractor shall instruct the Owner or his representative fully in the operations, adjustment and maintenance of all equipment furnished. Contractor shall provide at least two weeks notice to the General Contractor in advance of this period.

1.4 RECORD DRAWINGS

- A. See Division 1 for requirements associated with Project Record Drawings.

1.5 QUALIFICATIONS

- A. All mechanics shall be skilled in their respective trades.
- B. All welders shall be certified in accordance with the ASME Boiler Test Code, Section IX, latest issue.

1.6 SUBMITTALS

- A. See Division 1 for additional submission requirements.
- B. The Contractor shall submit a one (1) electronic copy (pdf format) of submittal brochures for review, or as indicated in Division 1. Brochures shall be submitted within thirty (30) days after contract award, or as indicated in Division 1.
- C. All submittals shall be submitted at one time. Partial submittals shall be returned to the Contractor unreviewed for completion and resubmittal.
- D. Complete data must be furnished showing quality, dimensions, complete certified characteristics of equipment, capacity, code requirements, motor drives, and certified performance curves for all fans and pumps. Include schedules for all cooling and heating equipment showing CFM and capacities at design conditions. No equipment or materials shall be purchased prior to receiving written notification from the Architect that submittals have been reviewed and marked as follows:
 - 1. REVIEWED - NO EXCEPTIONS (Contractor Resubmittal Not Required)
Reviewed manufacturer and equipment specifications. Appears to be in conformance with design drawings/specifications.
 - 2. REVIEWED - MAKE CORRECTIONS NOTED (Contractor Resubmittal Not Required)
Reviewed manufacturer and equipment specifications. Appears to be in conformance with design drawings/specifications. Minor adjustments required to the equipment options/accessories. Resubmittal not required if written acknowledgement is sent to the General Contractor and Architect that this items will be provided as corrected. Sub-contractor shall also provide final record submittal to the general contractor.
 - 3. REVIEWED - FOR RECORD ONLY (Contractor Resubmittal Not Required)
Reviewed only for coordination purpose only of another trade engineering submittals or contractor generated shop-drawings. (Often these are contractor generated installation drawings or 3rd party sealed design drawings (typically seismic engineering for MEP equipment/piping).
 - 4. REVISE & RESUBMIT (Contractor Resubmittal Required)
Specific manufacturer is acceptable. Equipment model, application, capacity, design parameters, code listing, testing listing is not acceptable or not provided. Resubmittal is required and all engineers' comments shall be addressed in summary memo attached with the resubmittal.
 - 5. REJECTED (Contractor Resubmittal Required)
Specific manufacturer is not acceptable and rejected. Manufacturer is not listed within project specs and was not prior approved within the timeframe required. Other model types/applications produced by the is manufacturer will not be accepted.

- E. Review and Approval of Submittals: Submittals will be reviewed with reasonable promptness, but only for conformance with the design concept of the Project and with the information indicated on the Drawings and stated in the Specifications. Approval of a separate item as such will not indicate approval of the assembly in which the item functions. Approval of submittals shall not relieve the Contractor of responsibility for any deviation from the requirements of the Contract Documents, nor shall approval relieve the Contractor of responsibility for the equipment fitting within the allotted space shown on the drawings with all clearances required for equipment operation, service and maintenance including a minimum of 4 feet clear in front of all electrical control equipment and panels, for errors or omissions in the submittals; or for the accuracy of dimensions and quantities, the adequacy of connections, and the proper and acceptable fitting, execution, functioning and completion of the Work.
- F. Use of accepted substitutions does not relieve the Contractor from compliance with the Contract Documents. Contractor shall bear all extra expense resulting from accepted substitutions where substitutions affect adjoining or related work required in this Division or other Divisions of this Specification.
- G. If Contractor substitutes equipment for that drawn to scale on the drawings, he shall prepare a 1/4" = 1'-0" fabrication drawing for each equipment room where a substitution is made, using dimensions of substituted equipment, to verify that equipment will fit space with adequate clearances for maintenance. This 1/4" = 1'-0" fabrication drawing shall be submitted and accepted by the Architect before construction begins.
- H. Unauthorized Substitutions: If substitute materials, equipment or systems are installed without prior approval or are installed in a manner which is not in conformance with the requirement of this Specification and for which the Contractor has not received written approval, removal of all the unauthorized materials and installation of those indicated or specified shall be provided at no extra cost to the Owner.
- I. Expense: All costs for the preparation, correction, delivery, and return of the submittals shall be borne by the Contractor.

1.7 PRIOR APPROVAL

- A. See Division 1 for substitutions and product options. In general, written requests must be received in the Architect's office ten (10) days prior to bid date to be considered. Verbal approvals will not be given.
- B. Requests for proposed substitutions shall be accompanied with catalog and technical data. Actual equipment components and options shall be highlighted and any discrepancies with the specified equipment noted.

1.8 IDENTIFICATION OF PIPING

- A. All exposed piping and piping concealed above accessible ceilings shall be labeled at 15 ft. intervals. In addition, piping concealed above rigid ceilings and inside walls and chases shall be labeled at each access door. Brady, Brimar, or accepted equivalent labels, as specified herein shall be used.

1.9 IDENTIFICATION OF VALVES

- A. Each valve shall be provided with a tag secured to the valve with metal chain or copper wire. Tag shall indicate both the service and function of each valve. Contractor shall furnish two sets of prints of drawing and showing floor plan for each floor with all valves accurately located and labeled. Drawing shall be submitted to the Architect in accordance with the requirements specified under Paragraph "Operating and Maintenance Instructions" in this Section. These drawings shall be neat and easily read. Tags shall be stamped brass (1-1/2" or 2" diameter) with 1/4" high figures.

1.10 IDENTIFICATION OF CONTROL SYSTEM DEVICES

- A. All automatic controls, control panels, zone valves, pressure electric, electric pressure switches, relays and starters shall be clearly tagged and identified. Wording shall be identical to that on the control diagram in the contract drawings.

1.11 UNDERGROUND PIPING SYSTEM IDENTIFICATION

- A. All underground facilities shall be locatable above ground without potholing. "Underground Facility" means any item of personal property that is buried or placed below ground for use in connection with the storage or conveyance of water, sewage, oil, gas or other substances, and shall include but not be limited to pipes, sewers, valves, lines, manholes, etc., and landscape irrigation systems of two inches in diameter or less. Metallic gas service lines installed on private property by the utility company are detectable without the following requirements:
 - 1. All buried nonmetallic private water lines and nonmetallic fire lines shall have a blue #18 insulated tracer wire securely attached to it at 8' o.c. and shall have 12" of tracer wire accessible above grade at the termination and be securely attached at that point.
 - 2. All buried nonmetallic private sewer lines shall have a green #18 insulated tracer wire attached to it at 8' o.c. and shall have 12" of tracer wire accessible above grade at the termination and be securely attached at that point.
 - 3. All buried nonmetallic private gas line shall have a yellow #18 insulated tracer wire attached to it at 8' o.c. and shall have 12" of tracer wire accessible above grade at the termination and securely attached at that point.
 - 4. All buried nonmetallic private landscape sprinkler lines greater than 2" in diameter shall have a purple #18 insulated tracer wire securely attached to it at 8' o.c. and shall have 12" of tracer wire accessible above grade at the termination and be securely attached at that point.
 - 5. All nonmetallic underground facilities including but not limited to mechanical, chilled water, refrigerants, or empty conduit shall have a white #18 insulated tracer wire attached to it at 8' o.c. and shall have 12" of tracer wire accessible above grade at the termination and be securely attached at that point.
- B. Where an installation of any of the above referenced items connects to a public utilities service facility that does not re-emerge above grade the tracer wire shall be securely attached at the point of such transition. Where the lines extend under a building without re-emerging above grade prior to entering a building the tracer wire shall be securely attached at the point where the transition occurs.
- C. Please note that these particular requirements pertain to underground facilities on private property and will be regulated by the Building Official (Building Department). They are in addition to requirements required by the Authority Having Jurisdiction. *Town of Queen Creek's adopted codes.*
- D. Detectable requirements for underground facilities in rights of way will be regulated and monitored by the Authority Having Jurisdiction. *Town of Queen Creek Engineering Department.*

1.12 OPERATIONAL TAGS

- A. Furnish and install equipment identification tags for all items of mechanical equipment furnished and installed under Division 15, including each air conditioning unit, exhaust fan, pump, air handling unit, fan coil unit, chiller, evaporative cooler, sound attenuator, and other equipment as listed in the mechanical equipment schedule.
- B. Mechanical equipment shall be labeled in an approved manner to permanently and uniquely identify each piece of equipment and the area served. Secure to units with screws at an appropriate location. Letters shall be engraved, 1/2" minimum.
- C. Labels for units located on roof or outdoors shall be a rust proof metal with engraved letters.

1.13 FLOW DIAGRAMS

- A. Install half size print of each system's flow diagram inside each VAV air handling unit.
- B. Furnish and install a flow diagram under plexiglass and frame for the chilled water system. Install on walls near to the system.

1.14 GUARANTEE-WARRANTY

- A. See Division 1 for warranties. As a minimum, the contractor shall warranty the entire mechanical system for a period of two years for parts and labor, unless specified in Division 1 to be a longer warranty period. The warranty period shall start from the date of beneficial occupancy.

PART 2 - PRODUCTS

2.1 QUALITY OF MATERIALS

- A. All equipment and materials shall be new, and shall be the standard product of manufacturers regularly engaged in the production of plumbing, heating, ventilating and air conditioning equipment and shall be the manufacturer's latest design. Specific equipment, shown in schedules on drawings and specified herein, is to set forth a standard of quality and operation.
- B. Manufacturer's nameplate, name, or trademark shall be permanently fixed to all equipment and material furnished under the specification.

2.2 ALTITUDE RATINGS

- A. Unless otherwise noted, all specified equipment capabilities are for an altitude of 1,200 feet above sea level and adjustments to manufacturers ratings must be made accordingly.

2.3 ELECTRICAL SERVICES - MOTORS

- A. Provide and install all motors as manufactured by General Electric, Reliance Motor Co., or accepted equivalent. Each motor, unless otherwise specified of 3/4 HP and greater, shall be designed for operation with 3 phase, 60 Hz, 460 volt electrical service. Unless otherwise specified, motors of 1/2 HP and less shall be designed for operation with single phase, 60 Hz, 120 volt electrical service. Motors shall be 1750 RPM, squirrel cage, normal starting torque and normal starting current, in accordance with NEMA standards unless otherwise specified. All motors 5 HP and above shall be high efficiency motors with a minimum efficiency of 0.87 and a minimum power factor of 0.85. Each motor shall be of the horsepower as specified and suitable for use at an altitude of 1,200 feet. All motors shall have grease lubricated sealed ball bearings. Motors larger than 1 hp shall have a standard grease fitting "zerk" and a separate grease relief tapping. Motors shall be factory lubricated. Motors shall be commercially dynamically balanced and tested at the factory before shipment and shall be selected for quiet operation.
- B. Motors for V-belt drives shall be provided with a cast iron or steel base, with slide rail and adjustable belt tension screw device. The Contractor shall line up motors and drives and place motors and equipment on foundations ready for operation.
- C. Provide totally enclosed, fan cooled (TEFC) motors outside the building or otherwise exposed to weather, or suitably protected per NEMA standards. Provide open drip proof motors generally inside the building, except where splash-proof or explosion proof construction is required.
- D. Provide single phase motors of permanent split capacitor type unless otherwise specified. Provide with integral thermal overload protection.

2.4 ELECTRICAL GROUNDING

- A. The mechanical piping system may be bonded to the electrical ground bus at the electrical service equipment, but shall not under any circumstances be used as the main grounding electrode for the electrical service.

2.5 V-BELT DRIVES

- A. V-belt drives shall be of fabric and rubber construction of accepted manufacturer. Multiple belts shall be matched and all belts shall be adjusted to drive the apparatus properly and to prevent slippage and undue wear in starting. Unless otherwise specified in the Mechanical Equipment Schedule, drive horsepower rating shall be 150 percent of the specified motor nameplate rating. Motor sheave shall be adjustable unless otherwise specified in the Equipment Schedule on the Drawings. All belts shall be "Standard" strength unless otherwise required. All V-belt drive equipment shall have a label showing type and size of belt required fastened to belt guard or other conspicuous location.
- B. If blower motor sheaves require replacement in order to obtain the scheduled air flows, the contractor shall furnish and install new sheaves, pulleys and belts and readjust the drives as necessary, at no additional cost.

2.6 PAINTING

- A. All finish painting of mechanical equipment, piping, ductwork, and conduit will be under Section 09 91 00, Painting, unless equipment is hereinafter specified to be provided with factory applied finish coats.
- B. All equipment shall be provided with factory applied finish, unless otherwise specified.

2.7 TOUCH-UP

- A. If the factory finish on any equipment is damaged in shipment or during construction of the building, the equipment shall be refinished to the satisfaction of the Architect.

2.8 ADHESIVES, SEALANTS, AND PRIMERS

- A. All adhesives and sealants used on the interior of the building (defined as inside of the weatherproofing system and applied on-site) shall comply with the requirements of the following reference standards:

1. Adhesives, Sealants, and Sealant Primers shall be under the maximum limits as set by the South Coast Air Quality Management District (SCAQMD) Rule #1168. VOC limits are listed in the table below and correspond to an effective date of July 1, 2005 and rule amendment date of January 7, 2005.

<u>ADHESIVES, SEALANTS SEALANTS PRIMERS</u>	<u>VOC Limit [g/L less water]</u>
PVC Welding	510
CPVC Welding	490
ABS Welding	325
Plastic Cement Welding	250
Adhesive Primer for Plastic	550
Contact Adhesive	80
Special Purpose Contact Adhesive	250
Multipurpose Construction Adhesives	70
Metal to Metal Adhesives	30
Plastic Foams	50
Wood	30
Fiberglass Adhesives	80

	Sealants	420
	Sealant Primers	750
2. Aerosol Adhesives shall be under the maximum limits as set by the Green Seal Standard for Commercial Adhesives GS-36 requirements in effect on October 19,2000.

<u>AEROSOL ADHESIVES</u>	<u>VOC Weight [g/L minus water]</u>
General Purpose Mist Spray	65% VOC's by weight
General Purpose Web Spray	55% VOC's by weight
Special Purpose (All Types)	70% VOC's by weight

2.9 BELT AND FAN GUARDS

- A. The Contractor shall provide for each V-belt drive a galvanized iron belt guard which shall be constructed around an angle iron frame, securely bolted to the floor or apparatus. The guard shall completely enclose drives and pulleys and be constructed to comply with all safety requirements. Hinged access doors not less than 6" X 6" shall be provided for access to motors and fan shaft for test purposes. Furnish wire mesh screen cover reinforced with bars or rods for propeller fans, installed so as not to restrict the air flow. All zerk fittings and oil cups shall be accessible without removing belt guards. All belt guards shall be constructed in accordance with OSHA requirements.

2.10 DUCTWORK AND PIPING SYSTEM IDENTIFICATION

- A. Means of Identification: All piping and duct systems shall be identified by each of the following means:
1. An identifying legend on color coded background appropriately worded to indicate the contents of the pipe or duct. Color coded banding shall also be provided.
 2. An arrow placed to indicate the direction of flow through the pipe or duct.
- B. Locations of Identification: The identifying legends and directional arrows described in the paragraphs preceding shall be located at the following points on each piping and duct system:
1. Adjacent to each valve in piping system.
 2. At every point of entry and exit where piping or duct goes through a wall.
 3. On each pipe riser and junction.
 4. Every 15 feet on continuous pipe lines exposed and concealed above accessible ceilings and on ductwork where located exposed in equipment rooms.
 5. Adjacent to all special fittings (regulating valves, etc.) in piping systems.
 6. At every access door.
- C. Directional Arrows: An arrow shall be placed to indicate the direction of flow through the pipe or duct. The arrow shall point away from other identifying marks. This arrow shall be black (except on extremely dark-colored background, where it shall be white). The "shaft" of the arrow shall be of a size as scheduled for letters. The "head" of the arrow shall be formed by an equilateral triangle having a base equal to twice the width of the shaft. If flow can be in both directions, use a double-headed arrow with a single shaft.
- D. Piping identification shall meet the standards of the Federal Occupational Safety Health Act (OSHA) which refers to the ANSI Standard A13.1 1956 (revised 1975). The following standardized color code scheme shall be used.
- | | | |
|--------|---|--|
| Yellow | - | Hazardous Materials |
| Green | - | Liquid Materials of Inherently Low Hazard |
| Blue | - | Gaseous Materials of Inherently Low Hazard |
| Red | - | Fire Protection Materials |

- E. The size of letter and length of color field shall conform to the ANSI standard and shall be as follows:

Outside Diameter of Pipe or Covering			Length of Color Field	Size of Letters
-----	to	1-1/4"	8"	1/2"
1-1/2"	to	2"	8"	3/4"
2-1/2"	to	6"	12"	1-1/4"
8"	to	10"	24"	2-1/2"
Over	10"		32"	3-1/2"

- F. Labels shall be applied to piping and ductwork utilizing an accepted rubber cement. In addition to being held with adhesive, both ends of the label shall be held in place with colored banding tape.

- G. Labeling and banding system shall be as follows:

Service	Label	Background Color	Banding
Domestic Cold Water	C.W.	Green	2" Green
Domestic Hot Water	D.H.W.	Green	2" Green & 1" Orange
Domestic Hot Water Recirculating	D.H.W.R.	Green	2" Green & 1" Orange
Soft Cold Water	S.C.W.	Green	2" Green & 1" Blue
Soft Hot Water	S.H.W.	Green	2" Green & 1" Blue
Fire Protection Line	F.L.	Red	4" Red
Sprinkler Line	S.L.	Red	4" Red
Compressed Air	C.A.	Blue	4" White
Roof Drain	R.D.	Green	4" Green
Sanitary Sewer	S.	Green	4" Green
Storm Sewer	S.S.	Green	4" Green
Natural Gas	Gas	Yellow	3/4" Yellow
Chilled Water Supply	C.H.W.S.	Green	4" Green
Chilled Water Return	C.H.W.R.	Green	4" Green

2.11 WALL AND CEILING ACCESS DOORS

- A. Provide all access doors required for access to valves, traps, unions, coils, cleanouts, junction boxes, expansion joints, dampers, controls, or other items for which access is required for either operation or servicing. All costs incurred through failure to perform this function as the proper sequence of this work dictates shall be borne by the Contractor. The type of access door shall be as required by the type of ceiling or wall. Verify with the architectural drawings for type required. Acoustical tile access doors shall be equivalent to Krueger Style B, Style A for acoustical plaster, Style C-CE for sidewall drywall or plaster construction. Stainless steel access doors shall be used where walls are tiled or in concession areas. Access doors in painted walls shall be primed. Verify with the architectural drawings for type of wall finish required.
- B. Access doors for mechanical devices shall not be less than 24" x 24" in size except that larger panels shall be furnished where required, and panels in tile or other similar patterned ceilings shall have dimensions corresponding to the tile or pattern module. Access doors for plumbing system shut-off valves shall not be less than 12"x12" in size, and panels in tile or other similar patterned ceilings shall have dimensions corresponding to the tile or pattern module.
- C. Where access doors are installed in walls required to have a specific fire rating, the access door installed shall be fire rated access door with U.L. label, as manufactured by Milcor or accepted equivalent. Access door in 1-hour construction shall be Class C and access doors in 2-hour construction shall be Class B.

- D. Access doors in painted areas shall be primed. Access doors in tiled areas shall be stainless steel. Refer to Architectural Room Finish Schedule.

2.12 PIPING ISOLATION FROM THE SUPPORT

- A. All copper piping shall be isolated from steel supports with factory manufactured isolators. Taping as substitution for manufactured isolators will be not accepted.

PART 3 - EXECUTION

3.1 COOPERATION WITH OTHER TRADES

- A. The Contractor shall fully examine the drawings and specifications of other trades to become familiar with all conditions affecting the work and consult and cooperate with other Divisions for determining space requirements and clearances with respect to other equipment, hangers, piping, and conduit in the building. The Architect reserves the right to determine space priority in the event of interference between piping, conduit, and equipment of various trades. Construction operations shall proceed without harm to the Owner from interference, delay, or absence of coordination.
- B. If work is installed without coordinating with other trades, and such installation interferes with their installation or proper clearances around equipment is not maintained, then make changes to correct the conditions without extra cost.
- C. The Contractor shall be responsible for the size and accuracy of all openings.

3.2 INTERRUPTING SERVICES

- A. The Contractor shall coordinate the installation of all work within the building in order to minimize interference with the operation of existing mechanical, plumbing, and utility systems during construction. Connections to existing systems requiring the interruption of service within the building shall be carefully coordinated with the Owner to minimize system downtimes. Requests for the interruption of existing services shall be submitted to the Architect in writing a minimum of two (2) weeks before the scheduled date. Absolutely no interruption of the existing services will be permitted without the written approval of the Architect.

3.3 INVESTIGATION OF CONDITIONS

- A. Examine the drawings and all available information concerning existing installation, structure, excavations, and local conditions bearing on labor, transportation, handling and storage of materials, etc. Visit the site to understand the nature and the scope of all work to be performed and verify existing conditions shown on the drawings. The submission of a bid will be taken as evidence that such an examination has been made and all conditions have been considered and verified.

3.4 DRAWINGS

- A. The mechanical drawings show the general arrangement of all piping, ductwork, equipment, etc., and shall be followed as closely as actual building construction and work of other trades will permit. The Architectural and Structural Drawings shall be considered as part of the work insofar as this information furnishes the Contractor with details relating to design and construction of the building. Architectural drawings shall take precedence over the mechanical drawings. Because of the small scale of the Mechanical Drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The Contractor shall investigate the structural and finish conditions affecting the work and shall arrange his work accordingly, providing such fittings, valves, and accessories as may be required to meet such conditions. Should conditions necessitate a rearrangement of piping, such departures and the reasons therefor shall be submitted by the Contractor to the Architect for approval in the form of detailed drawings

3.5 FIELD MEASUREMENTS

- A. The Contractor shall verify the dimensions and conditions governing his work at the building. No extra compensation shall be claimed or allowed on account of differences between actual dimensions, including dimensions of equipment, fixtures and materials furnished, and those indicated on the drawings. Contractor shall examine adjoining work, on which his work is dependent for efficiency, and shall report any work which must be corrected. Coordination of all mechanical work within the building will be the direct responsibility of the Contractor. Review of submittal data in accordance with paragraph "Submittals" shall in no manner relieve the Contractor of responsibility for the proper installation of the mechanical work within the available space. No waiver of responsibility for defective work shall be claimed or allowed due to failure to report unfavorable conditions affecting his work. Installation of equipment and systems within the building space shall be carefully coordinated by the Contractor with all building trades. Installation of mechanical equipment within the ceiling cavity shall be in the following order of priority:

1. Plumbing soil, waste and roof drain lines.
2. Supply, return and exhaust ductwork.
3. Chilled water piping.
4. Lighting, bus duct and electrical cable trays.
5. Fire sprinkler mains.
6. Domestic hot and cold water mains.
7. Vent piping (for waste system).
8. Fire sprinkler branch piping.
9. Domestic hot and cold water branch piping.

3.6 HANGERS, SUPPORTS, AND INSERTS

- A. Contractor shall provide support for all equipment, piping, and ductwork to the building structure. Contractor shall furnish all necessary structures, inserts, sleeves, and hanging devices for installation of mechanical and plumbing equipment, ductwork and piping, etc. Contractor shall completely coordinate installation of such devices with all trades and Sub-Contractors. Contractor must further verify with the Architect that the devices and supports are adequate as intended and do not overload the building's structural components in any way.
- B. Keep piping in proper alignment and prevent transmission of thrusts and vibrations. Hangers and supports shall be capable of screw adjustment after piping is installed. Hangers shall be finely adjusted in vertical and horizontal direction under operating conditions.

3.7 SEISMIC SUPPORTS

- A. The Contractor shall be responsible for all anchors and connections for the mechanical work to the building structure to prevent damage of equipment and systems due to earthquakes. The complete fire protection systems shall be supported as required to resist stresses produced by lateral forces as required by NFPA No. 13. Where mechanical equipment, piping, and ductwork is connected to the building structure, exact method and means of attachment to the structural system shall be accepted by the Architect.
- B. See Section 23 05 23 for requirements for seismic supporting of mechanical equipment and systems.

3.8 PIPING AND DUCTWORK SEALANT THROUGH WALLS

- A. Sealant shall be capable of sealing pipe, conduit, and duct openings to restore fire and smoke rated walls and floors to their rated integrity. Sealant shall be UL classified. All penetrations in fire and smoke rated wall or floor assemblies shall be closed with 3M, or accepted equivalent, fire barrier penetration sealing systems and installed in accordance with the terms of their U.L. listing.

3.9 PROTECTION OF MATERIALS AND EQUIPMENT

- A. The Contractor shall be responsible for the protection of all work, materials and equipment furnished and installed under this section of the specifications, whether incorporated in the building or not.
- B. The Contractor shall provide protection for all work where necessary and shall be responsible for all damage done to property, equipment and materials. Storage of materials within the building shall be accepted by the Architect prior to such storage.
- C. Pipe openings shall be closed with caps or plugs to prevent lodgement of dirt or trash during the course of installation.
- D. Plumbing fixtures shall not be used by the construction forces. At the completion of the work, fixtures, equipment and materials shall be cleaned and polished thoroughly and delivered in a condition satisfactory to the Architect.

3.10 TRENCHING AND BACKFILLING

- A. All excavation, trenching and backfilling required for the mechanical installation shall be provided by this Contractor. Excavation and backfilling shall be done in strict accordance with Division 2, Site Work and Section 23 01 20.

3.11 MANUFACTURER'S INSTRUCTIONS

- A. All equipment shall be installed in strict accordance with recommendations of the manufacturer. If such recommendations conflict with plans and specifications, the Contractor shall report such conflicts to the Architect who shall make such compromises as he deems necessary and desirable.

3.12 BASES

- A. Support equipment and other mechanical items on curbs, legs, concrete pads, or steel framework. Provide all curbs, bases, and supports not part of the building structure, unless indicated to be part of another Division. Furnish required foundation sizes, bolts, washers, sleeves, plates, templates, etc. for mechanical equipment provided. Equipment shall be set level.
- B. All concrete inertia bases shown and/or detailed on the mechanical plans will be furnished and installed under this section of the specifications and shall conform to the requirements specified under the Division 3 - Concrete, portions of these specifications. Contractor shall be responsible for the accurate dimensions of all pads and bases and shall furnish and install all vibration isolators, anchor bolts, etc.
- C. Housekeeping pad foundations for floor mounted equipment will be installed under Division 3 - Concrete of the specifications. Pad foundations shall be 4" high minimum, unless otherwise indicated on the drawings. Chamfer edges shall be 1". Faces shall be free of voids and rubbed smooth with carborundum block after stripping forms. Tops shall be level. This Contractor will be responsible for location and size of housekeeping pads for all mechanical equipment.
- D. Equipment anchor bolts shall be set in a galvanized pipe or sheet metal sleeves 1" larger than bolt diameter. Anchor bolts shall be high strength steel J shape. Anchor bolt design shall be arranged and paid for by the Contractor.
- E. Machinery bases, bed plates, sole plates, or vibration isolation units shall be carefully aligned, shimmed, leveled, then grouted in place with commercial non-shrink grout. When a flexible coupling is employed as a part of the drive train, the coupling shall be aligned before the machinery base is grouted.

3.13 CLEANING OF DUCTS

- A. Before the ceilings are installed and before ductwork located in tunnels or chases is covered, it will be required that the fans be operated at full capacity to blow out dirt and debris from ducts. If it is not practical to use the main supply blower for this test, the ducts may be blown out in sections by a portable fan.

3.14 EQUIPMENT FURNISHED BY OTHERS

- A. Certain items of equipment as listed on the drawings and/or specifications will be furnished by other Contractors or the Owner. This Contractor shall connect such equipment with utilities or ductwork to provide for proper operation in accordance with manufacturer's instructions.

3.15 LUBRICATION

- A. The Contractor shall provide all lubricants for the operation of all equipment until acceptance. The Contractor shall be held responsible for all damage to bearings while the equipment is being operated by him up to the date of acceptance of the equipment. The Contractor shall protect all bearings and shafts during installation.

3.16 TESTS

- A. All tests shall be conducted in the presence of the Owner's Representative. The Contractor shall notify the Architect one week in advance of all tests. Contractor shall make all necessary preliminary tests to ensure a tight system. Any joint found leaking under test shall be broken, cleaned, remade, and a new test applied. Requirements for testing are specified under the sections covering the various systems. The Contractor shall furnish all necessary equipment, materials, and labor to perform the required tests.

3.17 INSTALLATION CHECK

- A. An experienced, competent, and authorized representative of the manufacturer or supplier of each item of equipment indicated below shall visit the site of the work and inspect, check, adjust if necessary, and approve the equipment installation. In each case, the equipment supplier's representative shall be present when the equipment is placed in operation. The equipment supplier's representative shall revisit the job site as often as necessary until all trouble is corrected and the equipment installation and operation is satisfactory to the Architect.
- B. Each equipment supplier's representative shall furnish to the Architect a written report certifying that the equipment (1) has been properly installed and lubricated; (2) is in accurate alignment; (3) is free from any undue stress imposed by connecting piping or anchor bolts; and, (4) has been operated under full load conditions and that it has operated satisfactorily.
- C. Equipment requiring installation check includes, but is not limited to the following:
 - 1. Air Cooled Chillers
 - 2. Domestic Hot Water Heaters
 - 3. Chilled Water Pumps
 - 4. Pressure Reducing Stations
 - 5. RTU Air Handling Units (Chilled water/hot water, Chilled water w/ gas heating)
 - 6. VAV Terminal Units
 - 7. Exhaust Fans
 - 8. Vibration Isolators
 - 9. Mini-Split System Heat Pump Units
 - 10. Electric Heaters
 - 11. Make Up Air Units
 - 12. RTU DX historical/archive Desiccant Dehum

3.18 OPERATIONAL TEST

- A. After completion of testing, adjusting and balancing work, see Section 23 05 93, the Contractor shall make an operating test covering all equipment furnished and installed under Divisions 22 and 23. This test shall cover a period of not less than 24 hours. The Contractor shall have all of his equipment operating and check all equipment for adjustments. The Contractor will instruct the Owner's operating personnel in the operation and maintenance of the systems in all specified modes.
- B. Operational test shall be conducted by the Contractor with the assistance of the representatives from the Temperature Control Sub-Contractor and Testing and Balancing Sub-Contractor. Test shall be conducted in the presence of the Owner's Representative.

3.19 WARRANTY SERVICE

- A. Equipment items so noted will require factory authorized service personnel who shall provide all service, including all parts and all labor, as requested by the Owner during the full period of equipment warranty.

END OF SECTION

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SECTION 23 01 20

TRENCHING AND BACKFILL FOR MECHANICAL SYSTEMS

PART 1 - GENERAL

1.1 REQUIREMENTS

- A. Conform with applicable provisions of the General Conditions, Supplementary Conditions and the General Requirements

1.2 SCOPE OF WORK

- A. The work in this section includes the furnishing of all labor, materials, equipment, transportation, hauling and services required in connection with the excavation, backfilling, compaction, grading and removal of earth from the site required for the installation of the mechanical work specified herein under Divisions 22 and 23.

1.3 SAFETY REGULATIONS

- A. All work performed under this Section shall conform to the requirements of the General Conditions, Supplementary Conditions and Safety Requirements for this type of work.

PART 2 - PRODUCTS

Not Applicable.

PART 3 - EXECUTION

3.1 TRENCHING AND BACKFILLING FOR UTILITIES

- A. Contractor shall verify all existing grades, inverts, utilities, obstacles and topographical conditions prior to any trenching, excavation or underground installations. In event existing conditions are such as to prevent installations in accordance with Contract Documents, Contractor shall immediately notify General Contractor for decision. General Contractor's decision will be final and binding.
- B. Contractor shall provide and maintain warning barricades, flags, torches, etc., and shall conduct his work so as to create a minimum amount of inconvenience to others, traffic, construction and the like. Temporary suspension of work does not relieve the Contractor of responsibility for the above requirements.
- C. All trenches shall be kept away from footings a minimum of 1' horizontal for each foot of depth below nearest footing or trench shall be filled with concrete to an elevation such as to establish the required one-for-one ratio of proximity.
- D. General Excavation: The Contractor shall perform all excavation of every description and of whatever substances encountered, to the depths indicated on the drawings or with the top of piping not less than 24" below finished grade or not less than 6" below the frost line, whichever is greater. During excavation, material shall be piled in an orderly manner a sufficient distance from the banks of the trench to avoid overloading and to prevent slides or cave-ins. All excavated material not required or suitable for backfill shall be removed and wasted as indicated on the drawings or as directed by the General Contractor. Berming and grading shall be done as may be necessary to prevent surface water from flowing into trenches or other excavations and any water accumulating therein shall be removed by pumping or by other accepted methods. Sheet piling and shoring shall be done as required for the protection of the work and for the safety of personnel.

- E. Trench Excavation: Trenches shall be of adequate width for the proper laying of the pipe, and the banks shall be as nearly vertical as practicable and safe for workmen. Bottom of trenches shall be excavated a minimum of 6 inches below bottom of pipe. Bedding material shall be sand and shall be hand tamped in 6 inch layers. Bell holes and depressions for joints shall be dug after the trench bottom has been graded, and bedded in order that the pipe rests upon the prepared bottom for as nearly its full length as practicable. Care shall be taken not to excavate below the depths indicated. Where rock excavation is required, the rock shall be excavated to a minimum overdepth of 4 inches below the trench depths indicated on the drawings or specified.
- F. All below grade sewer piping shall have installed top of pipe elevations established at fifty (50) foot intervals witnessed by the General Contractor and recorded on the as-built drawing. All below grade piping installed within the building shall be dimensionally located from column lines and recorded on the as-built drawings.
- G. The Contractor shall move trucks and equipment on prescribed roads and keep the roads free from mud, dirt and spillage.
- H. If additional material is needed for fill on the project, it shall be furnished by the Contractor.
- J. Bracing and Bulkheading: In all excavation work the Contractor shall provide necessary underpinning, bracing, or bulkheading to safeguard the work, the present structures, workmen, the public, and the property, and shall assume all responsibility in connection therewith.
- K. Backfilling: The trenches shall not be backfilled until all required pressure tests are performed and until the utilities as installed conform to the requirements specified.
- L. Fill material shall be free from trash, lumber or any type of debris which may be detrimental to producing the required density in the fill.
- M. Optimum moisture content shall be maintained within 2% of the optimum moisture content at all times (Reference Soils Report). If the material is too dry, then water shall be added until the above moisture limits are reached. If the material is too wet, then it shall be mixed and blended with dry material or dried until the above moisture limit is reached.
- N. All piping not encased in concrete shall be bedded in sand or fine gravel, without rocks or other foreign material. Bedding material shall be placed around the pipe for the full width of the trench and shall extend at least 12" completely around chilled water cast iron pipe and 6" around all other piping directly buried. The bedding material shall be distributed around pipe to assure full consolidation.
- O. In grass and planted areas, the Contractor shall backfill his excavation to 8" below finished grade. Final 8" of backfill and all surface finish work will be done under Division 31, Earthwork.
- P. The Contractor shall protect from damage all existing underground utilities and utility tunnels indicated on the Contract Drawings (or field located for the Contractor by the Owner prior to excavation operations). Any damage to such existing utilities or utility tunnels shall be repaired by the Contractor without additional costs to the Owner.
- Q. Compaction density tests of trenching backfill are to be conducted as specified in Division 2. Costs for testing will be paid **for** by the Contractor. Re-tests of failed areas shall be paid for by the Contractor.

END OF SECTION

SECTION 23 05 19
PIPING SPECIALTIES

PART 1 - GENERAL

1.1 REQUIREMENTS

- A. Contractor shall furnish and install all piping specialties necessary for satisfactory operation of the systems. Conform with applicable provisions of the General Conditions, Supplementary Conditions and General Requirements.

1.2 RELATED SECTIONS

- A. See Section 23 01 00 for General Mechanical Requirements.
- B. See Section 23 20 00, Pipe and Pipe Fittings.
- C. Contractor shall furnish complete submittal data for all piping specialties, including manufacturer's specifications, class, type, catalog data sheets, etc.

PART 2 - PRODUCTS

2.1 STRAINERS

- A. Strainers shall be Sarco Type SB, or accepted equivalent by Keckley, Crane, Mueller, Wheatley or Fisher. Screens shall have 1/8" perforations for water service and 1/16" perforations for steam service. Every strainer shall be provided with a blow-off valve full size of strainer trapping. Before acceptance of the project, each strainer screen shall be removed and cleaned.

2.2 BASKET Y-STRAINERS

- A. Basket Y-Strainers 2" and larger shall be standard flanged ANSI-125, cast iron body, bolted cover, type 304 stainless steel screen, suitable for condensing water service, 125 maximum working pressure at 353 degrees F maximum temperature, Sarco model 528-B-125, or equivalent.

2.3 PRESSURE GAUGES

- A. Pressure gauges shall be Marshalltown "Permagage", Ashcroft "Duragage", Weiss 4UGN-1, Trerice No. 500X or 601, Duro 105, Winter, or accepted equivalent. Dials shall be 4-1/2" unless otherwise noted. Provide Crane No. 88 or accepted equivalent needle valve for each gauge and syphon for each steam gauge. Select gauge so that operating pressure is near the midpoint of the scale. Mount gauges so that they are easily readable while standing on the floor.

2.4 THERMOMETERS AND THERMOMETER WELLS

- A. Furnish Moeller, Trerice, Jay Weksler, Albert Weiss Co., Duro, Winter, or accepted equivalent 7-inch scale red reading thermometer with separable socket and expansion heads. Thermometer wells shall be equivalent to H.O. Trerice No. 5572.
- B. Thermometers shall be easily readable from ground level. Where vari-angle thermometers are required for this purpose, use Trerice BX914 - 9" adjust angle, or accepted equivalent.

2.5 MANUAL AIR VENTS

- A. Manual air vents shall be equivalent to Crane No. 88 bronze needle valve. Armstrong 71 & 75 approved equals.

2.6 AUTOMATIC AIR VENTS

- A. Automatic air vents shall be 3/4" and equivalent to Hoffman No. 78, Empire 905, or Armstrong No. 1-AV, 150 PSI working pressure, complete with inlet needle valve, Crane No. 88 and outlet piped to nearest floor drain.

2.7 TEMPERATURE AND PRESSURE TEST PLUGS

- A. Where shown on the drawings, and on the inlet and outlet of each coil, heat exchanger, heating and cooling water generating equipment, heat rejection equipment and heat recovery equipment and 3-way control valve, provide temperature and pressure test plugs with Nordel valve cores and 1/2" NPT brass body with gasketed cap. Test plugs shall be Peterson Equipment #110, Sisco, or accepted equivalent. The combination pressure temperature test wells shall be a minimum of 1/2" standard pipe thread. A Pressure and Temperature Test Kit shall be supplied and presented to the Owner. Test kit shall consist of (two) 4" Duro #105 pressure gage, 1/2 of 1% accuracy, 0-60 Psi range with 1/4" gage adapters; (two) 4-1/2" Duro pressure gauge, 1/2 of 1% accuracy, 0-100 Psi range with 1/4" gage adapters; (two) 2" Tel-Tru #39R Bi-metal thermometer with 8" stem, 1/2 of 1% accuracy, -40 deg. F to 160 deg. F; (two) 2" Tel-Tru #39R Bi-metal thermometer with 8" stem, 1/2 of 1% accuracy, 0 deg. F to 220 deg. F and a protective carrying case. Texas Fairfax approved equivalent.

2.8 MANUAL FLOW CONTROL VALVES

- A. Furnish and install manual flow control valves as indicated on the drawings. The valves shall be "Armstrong CBV", "Flowset", "Gerand", "Griswold", or approved equal combination shut-off and calibrated balancing valve with bubble tight shut-off valve, memory locking device, pressure gauge taps, and metal identification tag.
- B. Each manual flow control valve is to be furnished with a bronze strainer selected by the manufacturer to prevent clogging of the valve. Accuracy shall be within 5% of actual flow, maximum pressure drop 36" w.g. at scheduled flow rate.
- C. Provide one (1) portable differential meter with 4-1/2" dial, two (2) 5 foot meter hoses, shut-off valves, purge valves, and heavy duty carrying case. Turn over to owner for balancing in future.
- D. Furnish pre-formed insulation enclosure so that maintenance or inspection can be easily achieved and then restored to the insulating condition without destroying the insulation.

2.9 TRIPLE DUTY VALVE

- A. At the contractor's option, triple duty valves as manufactured by Bell & Gossett, Taco, Armstrong or equivalent maybe utilized at the pump discharge in lieu of non-slam check valve and balance/shut-off valve. Triple duty valve shall incorporate non-slam check valve with spring-loaded weighted disk and a calibrated adjustment feature permitting regulation of pump discharge flow and shut-off. Valves shall be designed to permit re-packing under full line pressure. Unit shall be installed on discharge side of pump in a horizontal or vertical position with the stem up. Unit shall be cast iron body construction suitable for maximum working pressure of 174 psig and a maximum operating temperature of 300 degrees F, bronze disk and seat, stainless steel stem and spring.

2.10 FLEXIBLE CONNECTIONS

- A. Furnish and install flexible connections at locations indicated on the drawings and at all piping connections associated with equipment mounted on or hung from vibration isolators. Flexible connections shall be constructed of multiple ply Kevlar cord fabric and EPDM cover and liner, operating pressure 150 psig at 220 degrees F through 12" size, and operating pressure 125 psig at 220 degrees F for sizes 14" through 24". Provide high temperature liner for applications with fluid temperatures in excess of 225 degrees F.

- B. Flexible connectors shall be single or twin sphere with Class 150 flange connections for sizes 2-1/2" and larger and threaded connections with galvanized female unions for sizes 3/4" through 2". Mason Industries SFEJ, SFDEJ, SFU, or equivalent by Twin City Hose.
- C. Installation of flexible connectors shall be in strict accordance with the manufacturer's recommendations. Spacing between piping system flanges shall be based on the flexible connector's expanded length corresponding to the system's operating pressure. Control rods or cables shall be provided for units installed in unanchored applications where system operating pressure and dynamic forces exceeds the manufacturer's recommendations for unrestrained installations.
- D. For piping systems utilizing grooved pipe with mechanical couplings, flexible connector's consisting of a minimum of three (3) stacked couplings, equivalent to Victaulic Style 75, between 6" long grooved nipples may be substituted for the neoprene units specified herein.

2.11 DIRT AND AIR SEPARATOR

- A. Furnish and install air and dirt separator as shown on the drawings. All fittings shall be fabricated steel, rated for 150 psig design pressure and be selected for less than 1 foot of water pressure drop and velocity not to exceed 4 feet per second through the unit at specified GPM. Performance curves from the unit manufacturer shall be furnished as part of the submittal for each unit. Units to include internal coalescing medium to facilitate maximum air and dirt separation and suppress turbulence. Alternate units shall be furnished with galvanized steel strainer and stainless steel collector tube for a similar purpose. Provide integral high capacity float actuated air vent at top fitting of tank. Alternates must include cast iron float actuated air vent rated at 150 psig which shall be threaded to the top of the fitting. Unit shall have the bottom of the vessel extended for dirt separation with the system connection nozzles equidistant from the top and bottom of the vessel and include a blowdown connection and valve. Include flanged pipe connections.
- B. Dirt and air separators shall be Spirotherm or approved equal.

2.12 EXPANSION TANK

- A. Furnish and install, as shown on the plans, full volume bladder expansion tank with welded carbon steel construction, easily replaceable chlorobutyl rubber bladder, support base ring suitable for mounting tank in the vertical position, and lifting lug. Tank shall include a single NPT system connection, and 1/4" NPT tap with air charge valve. Tank shall be factory pre-charged to 12 PSI, and the pre-charge pressure shall be field adjustable. Tank shall be constructed in accordance with ASME Section VIII, Division 1, for 150 PSI maximum working pressure and 240°F maximum operating temperature. Tank to be suitable for mounting in either a vertical or horizontal position as indicated on the plans. Exterior of tank shall have a factory applied rust proof gray primer oxide finish. Bladder type expansion tanks shall be specifically designed for use in hydronic systems and non-potable hydro-pneumatic applications, and shall be as manufactured by The John Wood Company, B&G, TACO Inc., MEPCO, or prior approved equal.

2.13 WATER PRESSURE REGULATING VALVES

- A. Furnish and install water pressure regulating valves, Watts U5B, Conbraco 36 series, or equivalent, 3/4" size minimum for water make-up to all hydronic systems and at other locations as shown on the drawings. Water pressure regulating valves shall be brass body, union inlet with integral strainers, 300 psig maximum working pressure, with built-in thermal expansion bypass.
- B. For high water capacity applications provide Watts 2235B or equivalent.
- C. Provide high or low pressure range depending on application requirements. Set pressure as indicated on the drawings, or as required to provide a minimum system pressurization of 12 psig at the system's highest point for closed circuit hydronic systems, or as recommended by the equipment manufacturer's.

2.14 WATER TEMPERATURE AND PRESSURE RELIEF VALVES

- A. Furnish and install ASME labeled, National Board stamped water temperature and pressure relief valves, Watts, Conbraco or equivalent, for all domestic water heaters, domestic water storage tanks, and other locations as indicated on the drawings.
- B. Water temperature and pressure relief valves shall be sized for the full system heating capacity at 210 degrees F maximum operating temperature and shall be furnished with the required valve thermostat tube extension length.

2.15 WATER REDUCED PRESSURE BACKFLOW PREVENTER

- A. Furnish and install water reduced pressure backflow preventers, as approved and accepted by the Town of Gilbert, Febco model 825Y, Conbraco 40 Series or equivalent. 3/4" minimum size shall be provided for water make-up to all hydronic systems. Backflow preventers shall be provided at other locations as shown on the drawings. Reduced pressure backflow preventers shall include two shut-off gate or ball valves, two check valves, pressure relief valve, and four test cocks. Units shall be factory assembled, tested, and certified. Units 2" and smaller shall be brass body, threaded connections, 175 psig maximum working pressure. Units 2-1/2" and larger shall be provided with flanged connections.
- B. Water reduced pressure backflow preventers installation shall be in accordance with the manufacturer's instructions and Town of Gilbert's requirements for access for testing and inspection.
- C. See Specification Section 22 70 00, Outside Utilities, for backflow protection associated with site water supply system.
- D. See Specification Section 22 11 00, Building Water Supply System, for backflow protection associated with building domestic water supply system.

2.16 HOSE KITS

- A. At the contractor's option, furnish pre-assembled hose kits including but not limited to isolation ball valves on supply and return, strainers, manual flow control valve, unions, 3-way or 2-way control valves, air vents, P&T test valves, drain valves, tees, fire rated hoses, and other components as required. Individual components shall be as specified above in other sections of this specification.
- B. Supply and return hoses shall be maximum of 18" long and equipped with swivel end connections at terminal unit. All end connections shall be crimped to meet stated pressure ratings, serrated or slip fit connections are not acceptable. Hose material shall be stainless steel braided over synthetic polymer liner. Hoses shall meet or exceed ASTM D-380-83 standard and withstand working pressures of 150 psi at 200 degrees F. Hoses shall meet or exceed flame retardant testing per UL #723.
- C. Insulated hoses shall be a 1" thick, high quality polyethylene pipe insulation.
- D. Contractor shall install hose kits in a straight and true method and not use the flexible hose to offset piping to unit connection. See unit connection detail on drawings for required access clearances around units.

2.17 SOLENOID VALVES

- A. Furnish and install electric solenoid valves as shown on the drawings and as required for the operation of the mechanical systems. Solenoid valves shall be 115 volt, single phase, 60 hz, two-way arrangement, two-positions with normally closed or normally open arrangement as required for the application. Solenoid valves associated with safety protection of systems including freeze protection, drain down, etc. shall be provided such that in the event of a power failure the system shall fail to a safe operating condition. Solenoid valves shall be as manufactured by ASCO or equivalent.

- B. See Section 23 01 00, General Mechanical Requirements and Section 23 09 50, Electrical Systems Controls for requirements associated with electrical control and power wiring for solenoid valves. Furnish hazardous duty enclosure where required by the application.

2.18 FLOW SWITCHES

- A. Furnish and install flow switches where required for protection and/or monitoring of mechanical equipment including water chillers, boilers, pumps, etc., and as otherwise shown on the drawings and the equipment schedule.
- B. Flow switches shall be either paddle type or differential pressure type as required by the application and as shown on the drawings, except differential pressure type flow switches shall be utilized for water chillers and other applications where minor pressure fluctuations could cause nuisance tripping of equipment operation.
- C. Paddle type flow switches shall be McDonnell and Miller Model FS7-4 Series designed for industrial duty, brass body and trim, 300 psig maximum working pressure, paddle size as required for application, single pole double throw switches, with electrical rating of 7.4 full load amps at 115 volt ac. Flow switches shall be installed in the horizontal pipe with inlet and outlet conditions necessary to provide trouble free operation.
- D. Differential pressure flow switches shall be Honeywell Model 406 series or equivalent, adjustable pressure differential setting, dustproof mercury switch enclosure, 1/4" NPT bellows connections, single pole, single throw switch, with electrical rating of 7.2 full load amps at 115 volts ac.
- E. Differential pressure switches shall be properly supported on the equipment controlled or wall mounted adjacent to the equipment or piping system.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All specialties shall be installed in accordance with the best standard practices and as recommended by the manufacturer.
- B. Where thermometers or test fittings occur in insulation piping systems or on insulated equipment, extension necks shall be provided to extend beyond the insulation.
- C. Manual air vents shall be installed at the high points in all heating and cooling piping systems, whether shown on the drawings or not.
- D. Automatic air vents shall be installed at locations indicated on the drawings. Automatic air vents shall be installed level and in accordance with manufacturer's directions, complete with individual isolation valves.

3.2 STRAINERS

- A. All strainer screens, including basket strainers and suction diffusers, shall be removed and cleaned prior to commencing testing and balancing work and shall be maintained clean through the project final acceptance by the Owner. Suction diffuser start-up strainers shall be removed prior to final testing and balancing.

3.3 TEST AND ADJUSTMENT

- A. Contractor shall field adjust all water pressure regulating valves, flow switches, water level controls, and specialties to provide required system operation.
- B. Contractor shall field test and verify the operation of all safety devices including water relief valves, and temperature and pressure relief valves.

3.4 RELIEF VALVE DISCHARGE

- A. Water pressure relief valve and water temperature and pressure relief valve discharges shall be piped full size to the outside of the building or discharged indirectly in a properly sized building floor drain or floor sink as approved by the Architect and allowed by the Building Mechanical and Plumbing Codes. When the operating discharge temperature is in the excess of 212 degrees F, the discharge shall be equipped with a splash shield or centrifugal separator.
- B. Water reduced pressure backflow preventer discharge shall be piped full size to the outside of the building or discharged indirectly in a properly sized building floor drain or floor sink as approved by the Architect and allowed by the Building Mechanical and Plumbing Codes. Provide a bronze air gap funnel with stainless steel fasteners for installation under reduced pressure backflow preventer relief valve. Febco Model AGD or equivalent, 1" discharge pipe size for backflow preventer through size 2".

END OF SECTION

SECTION 23 05 23

VALVES

PART 1 - GENERAL

1.1 REQUIREMENTS

- A. Conform with applicable provisions of the General Conditions, Supplementary Conditions and General Requirements.
- B. Lead Ban: Valves used in the installation of piping systems delivering water for human consumption shall be lead free. The term lead free is defined as valves which do not contain more than 8.0% lead.

1.2 RELATED SECTIONS

- A. See Section 23 60 00 for Valves in special piping systems.
- B. See Section 23 01 00 for General Mechanical Requirements.
- C. See Section 23 01 00 for Valve Identification.
- D. See Section 23 05 19 Piping Specialties.
- E. See Section 23 20 00 for Pipe Fittings.
- F. See Section 23 23 00 for Refrigerant Piping.
- G. See Section 25 00 00 for Automatic Temperature Control Valves.

1.3 SCOPE

- A. Contractor shall furnish and install all valves and accessories necessary for satisfactory operation of the systems. All valves are to be of domestic manufacture only.
- B. Contractor shall submit complete submittal data, See Section 23 01 00, for all valves including manufacturer's specifications, class type, catalog data sheets, etc..

1.4 VALVE REQUIREMENTS

- A. All valves except lubricated plug valves and butterfly valves shall be manufactured by Milwaukee, Crane, NIBCO, Kennedy, Stockham, Walworth, Powell, Watts, Hammond, Conbraco, or accepted equivalent.
- B. Lubricated plug valves shall be manufactured by Resun, Nordtrom, Rockwell or Walworth.
- C. Butterfly valves shall be manufactured by Milwaukee, Centerline, SSI, Crane, Keystone, Victaulic, NIBCO, Watts, or Dezurik. Butterfly valves may be used for closed circuit chilled water service. Butterfly valves shall not be used for domestic water or other non-specified service and shall not be used for balancing water flow.
- D. Gate valves are not acceptable in any system.
- E. Valves installed in insulated piping systems shall be furnished with valve stem extensions.

- F. Butterfly valves may be substituted for globe and ball valves for specified services other than domestic water, and for other services as may be approved by Engineer.
- G. All valves of the same type shall be products of a single manufacturer. Provide globe valves with packing that can be replaced with the valve under full working pressure.
- H. Provide chain operators for valves 4" and larger installed within mechanical equipment spaces where valves center line is in excess of eight feet above the floor or operating platform and as otherwise indicated on the drawings.

PART 2 - PRODUCTS

2.1 BALL VALVES

- A. Ball valves shall be cast of ASTM B-62 or B-584 bronze, 600 lb. W.O.G. 150 lb. WSP, chrome plated ball, full port, blow-out proof, threaded gland follower, reinforced teflon seats, N.A. packing, full port type. NIBCO T-585-70 threaded, S585-70 soldered, or Apollo 77-100 threaded, 77-200 soldered, or Watts B-6080 threaded, B6081 soldered.

2.2 GLOBE VALVES (125 PSI)

- A. 2" and Smaller: NIBCO T-211-B, Milwaukee No.502, or Watts B-4000, bronze body, bronze disc, screwed connection, for general steam, water, oil or air service, 200 PSIG W.O.G. maximum working pressure, 125 PSI steam working pressure.
- B. 2-1/2" and Larger: NIBCO F-718-B, Milwaukee No. F-2891A or Watts F-501, iron body, bronze trim, Class 125 flange connections, for general steam, water, oil or air service, 200 PSIG W.O.G. maximum working pressure, 125 PSI steam working pressure.

2.3 GLOBE VALVES, 2" AND SMALLER (350 PSI)

- A. NIBCO T-585-70UL / T-580-70UL, Milwaukee No. BB2-100, for compressed air, gasoline, light oils, volatile fluids and similar service to 400 PSIG maximum working pressure, Underwriters Laboratory approved for liquified petroleum gases, bronze body, union bonnet, composition disc, screwed connections.

2.4 GLOBE VALVES FOR COPPER PIPE (125 PSI)

- A. NIBCO S-211-B (Bronze Disc) / NIBCO S-211-Y (TFE Disc), Milwaukee No. 1502 or Watts B-4001-T, 2" and smaller, bronze body, composition disc, solder-joints for copper pipe, 125 PSI steam working pressure, 200 PSI water, 200 deg. F.

2.5 SWING CHECK VALVES, 2" AND SMALLER (200 PSI)

- A. NIBCO T-453-B, Milwaukee No. 518 or Watts B-5020, Y-pattern, horizontal swing, bronze body, bronze trim, screwed connections, for steam, water, oil, air or gas service, 400 PSIG maximum W.O.G. working pressure, 200 PSI steam working pressure.

2.6 SWING CHECK VALVES, 2-1/2" AND LARGER (125 PSI)

- A. NIBCO F-918-B, Milwaukee No. F2974 or Watts F-511, iron body, bronze trim, Class 125 flange connections, for steam, water, oil, air or gas service, 200 PSIG W.O.G. maximum working pressure, 125 PSI steam working pressure.

2.7 SWING CHECK VALVES, 2-1/2" AND LARGER (250 PSI)

- A. NIBCO F-968-B, Milwaukee No. 1509 Cast Iron body, bronze seats, bronze disc through 3" size, iron disc 4" and larger, Class 250 flange connections, for steam, water, oil and air service, 500 PSIG W.O.G. maximum working pressure, 250 PSI at 450 deg. F steam working pressure.

2.8 SWING CHECK VALVE (FIRE PROTECTION SYSTEM)

- A. NIBCO F-908-W, Crane No. 357, Underwriters Laboratory and Factory Mutual approved and labeled for fire protection service, 2-1/2" through 10", 175 PSI working pressure, ferro steel body, clearway swing check, Class 125 flange connections.

2.9 SWING CHECK FOR COPPER PIPE (125 PSI)

- A. NIBCO S-413-B (Bronze Disc) / NIBCO S-413-Y (TFE Disc) Milwaukee No. 1509 or Watts B-5001, 2" and smaller, bronze body with solder-joint for copper pipe, 125 PSI steam working pressure, 200 PSI water, 200 deg. F.

2.10 BALANCING COCKS

- A. 1-1/4" and Smaller (125 PSI): Milwaukee No. BB2-FS100 square head brass cock or Watts CSM-61 -M1 1/4 turn ball valve, Series 21, bronze body and trim, TFE seats and seals.
- B. 1-1/4" and Smaller (250 PSI): Crane No. 8E square head brass cock or Jamesbury "Clincher" 1/4 turn ball valve, Series 21, bronze body and trim, TFE seats and seals.
- C. 1-1/2" and 2" (125 W.O.G.): Walworth lubricated plug valves, Figure 1796 with screw connections through 2" size or Watts CSM-61-M1.
- D. 2-1/2" and Larger (125 W.O.G.): Walworth Figure 1797, Class 125 flange connection or Watts CSM-91, high strength cast iron, short pattern, low friction coated plug, lever handles through 4" size, 5" and larger with worm gear and wheel handle operator; or Watts equivalent.
- E. 1-1/2" and Larger (200 W.O.G.): Walworth lubricated plug valves, Figure 1700 with screwed connections through 2" size, Figure 1700F, Class 250 flange connection 2-1/2" and larger, high strength cast iron, regular pattern, low friction coated plug, lever handles through 4" size, 5" and larger with worm gear and wheel handle operator.

2.11 BUTTERFLY VALVES (200 PSI)

- A. Full-lug type, iron body, aluminum bronze disc, stainless steel shaft, and with "EPDM" (-30 deg. F to 225 deg. F) molded-in liner for tight shut-off and dead-end service without downstream flange attached. Valves to be for mounting between flanges, with the lugs drilled and tapped so that pipe may be disconnected on either end while opposite end is under pressure. Valves 4" and smaller to have lever operators with infinite positions, and a locking device for securing in any position. Valves 5" and larger to have worm gear and hand wheel manual operators. Victaulic type butterfly valves with grooved ends may be used provided they meet the above specifications. If larger than 12", use valves with flanged ends. NIBCO LD-2000 or approved equal.
- B. Valves 4" and smaller shall be provided with level handler operator with spring loaded lock stops. Valves 5" and larger shall be furnished with manual gear operator with hand wheel.
- C. Valves installed on insulated services shall be provided with extensions, as required, such that operator does not interfere with insulation or insulation jacketing.
- D. Butterfly valves furnished for use in grooved piping system shall meet the material specification requirements as specified herein.

2.12 MANUAL AIR VENTS AND GAUGE VALVES

- A. Crane No. 88 bronze needle valve.

2.13 DRAIN VALVES

- A. Milwaukee No. 1169, Watts B-3110.

2.14 WATER PRESSURE RELIEF VALVES

- A. For makeup to all cooling systems, and relief for cooling system, Bell and Gossett No. 480, or accepted equivalent, with setting of approximately 5 PSI above system operating pressure.

2.15 WATER PRESSURE REDUCING VALVES

- A. For makeup to cooling systems, Watts No. 223.

2.16 PUMP DISCHARGE CHECK VALVES

- A. NIBCO W-960-W, Williams-Hager Figure 375, 125 PSIG to 300 PSIG pressure rating as required by system operation, center-guided, wafer type with Buna-N inserts for water, oil or gas (-20 deg. F to 250 deg. F), semi-steel body, bronze trim, sizes 2" through 8". Sizes 10" to 24" globe type Figure 636 with ANSI flange connections to match piping system. NIBCO F-960-W, Armstrong "FTV" approved equals.

2.17 NATURAL GAS VALVES, 1-1/2" AND SMALLER

- A. Shall be manufactured by Milwaukee BB2-100.

2.18 NATURAL GAS VALVES, 2" AND LARGER

- A. Lubricated plug valves shall be manufactured by Resun, Nordtrom, Rockwell or Walworth.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All valves shall be installed in locations which will allow easy operation and facilitate maintenance.
- B. Globe valves shall be installed with stems above horizontal.
- C. Valves installed on insulated services shall be provided with extensions, as required, such that operator does not interfere with insulation or insulation jacketing.
- D. Provide chain operators for valves 4" and larger installed within mechanical equipment spaces where valves center line is in excess of eight feet above the floor or operating platform and as otherwise indicated on the drawings.

END OF SECTION

SECTION 23 05 48

VIBRATION AND ISOLATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 REQUIREMENTS

- A. Conform with the applicable provisions of the General Conditions, Supplementary Conditions, and General Requirements.

1.2 RELATED SECTIONS

- A. See Section 23 01 00 for General Mechanical Requirements.
- B. See Section 23 20 00 for Pipe and Pipe Fittings.
- C. See Section 23 21 00 for Chilled Water System.
- D. See Section 23 30 00 for Air Tempering System.

1.3 SCOPE

- A. Furnish and install vibration isolation, complete as indicated, specified and required.

1.4 SUBMITTALS

- A. See Section 23 01 00 for general requirements for submittal materials. In addition to the requirements contained in Section 23 01 00, provide submittal information for all products and materials covered under this Section of the Specifications as listed herein.
- B. Furnish complete catalog data on all vibration isolators and equipment vibration bases to be utilized for the project in order to establish compliance with the plans and specifications. Indicate where isolator is to be used.
- C. Furnish complete shop drawing information including construction details for all vibration bases; support points and anchor bolt requirements and locations; method of support for piping; and method of isolation for piping passing through the building structure.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

- A. Floor mounted vibration isolators shall be neoprene mountings with a minimum deflection of 0.35". All metal surfaces shall be neoprene covered and have friction pads, top and bottom. Mason Type ND.
- B. Hanger type vibration isolators shall consist of a steel spring in series with a neoprene element. Spring and hanger lower hole diameters shall be large enough to permit the hanger rod to swing through a 30 degree arc from side to side. Mason Type 30N.
- C. Neoprene pads shall be sized for 0.1" deflection and consist of a 3/4" thick neoprene pad molded in 2" square waffle modules, a minimum 1/4" thick steel load distribution plate, a steel bolt torque sleeve, and a one-piece molded bridge bearing neoprene anchor bolt bushing with a flat washer face to avoid metal to metal contact. Pads shall be Type SWM, bolt torque sleeves Type BTS, and grommets Type HG as manufactured by Mason Industries, Inc.

- D. All vibration isolation devices shall be furnished by a single manufacturer.
- E. Spring isolators shall have spring diameters no less than 80% of the compressed height of the spring at rated load and have a minimum additional travel to solid equal to 50% of rated deflection.
- F. Vibration isolators shall have a minimum static deflection as specified on the drawings. Isolators shall be selected by the manufacturer for non-resonance with the equipment forcing frequency and the building structure's natural frequencies. Isolators shall be provided for suitable mounting to equipment and supporting structure.
- G. Vibration isolators shall be furnished by Mason, Kinetics, Amber/Booth, Vibration Elimination Co., or approved equal.

2.2 EQUIPMENT BASES

- A. Vibration isolation bases shall be furnished by the vibration isolation manufacturer or shall be constructed by the Contractor as detailed on the drawings and as required for the application.
- B. Structural steel bases shall be designed and supplied by the isolator manufacturer. Mason Type WFSL, or approved equal. Bases shall be designed with isolator brackets to reduce the mounting height of the equipment. To assure adequate stiffness, the height of the members shall be a minimum of 10% of the longest span between isolators, or at least 6 inches, except where thinner sections are necessary, due to head room limitations, etc.
- C. Reinforced concrete inertia bases shall be designed by the isolation manufacturer who shall furnish the steel framework, Mason Type BMK, or approved equal. The Contractor shall furnish and install concrete, poured into the welded steel frame. The steel framework shall incorporate prelocated equipment anchor bolts, 1/2" diameter reinforcing bars on nominal 8" centers each way, and recessed isolator mounting brackets to reduce the mounting height of the equipment, but yet remain within the confines of the base. The thickness of the base shall be a minimum of 10% of the longest span between isolators, at least 6", or as indicated on the drawings. Where inertia bases are used to mount pumps, the bases shall be long enough to support piping elbows.

2.3 FLEXIBLE CONNECTIONS

- A. Flexible connections for piping systems shall be as specified in Section 23 20 00 and Section 23 05 19. Flexible connection for fan equipment and flexible ductwork shall be as specified in Section 23 30 00 .

2.4 PIPE ISOLATION

- A. At connections to sprung mechanical equipment, and as shown on Drawings, provide flexible piping connectors as described in Specification Sections 23 20 00 and 23 05 19.
- B. On horizontal piping, provide hanger type vibration isolation as described above , except they shall be pre-compressed to the rated deflection so as to keep the piping at a fixed elevation during installation. The hangers shall be designed with a release mechanism to free the spring after installation is complete and the hanger is subjected to its full load. Mason Type PC30N.
- C. Application of pipe isolation as follows:
 - 1. Chilled water piping in Mechanical Rooms containing floor mounted air handling units.
- D. Minimum steel spring deflections:
 - 1. First four (4) isolators adjacent to sprung mechanical equipment shall have same static deflection as the vibration isolators supporting the equipment.

2.5 PLUMBING

- A. Provide Hubbard Holdrite "Silencer" product line for all water, waste and vent piping in all restrooms.

PART 3 - EXECUTION

3.1 GENERAL

- A. All mechanical equipment scheduled on the drawings shall be isolated from building structure by means of resilient vibration and noise isolators supplied by a single manufacturer to the Contractor. The isolator manufacturer shall submit a tabulation of the design data on the isolators including spring O.D., free operating and solid heights of springs, free and operating heights of neoprene isolators. Static deflection scheduled is the minimum acceptable and represents the static deflection required based on the combined weight of the equipment; motor bases and any other accessories specified in the mechanical equipment schedule. Isolation bases shall be furnished by the Vibration Isolator Manufacturer or shall be constructed as detailed on the mechanical drawings by the Contractor. If constructed by the Contractor, it shall be his responsibility to coordinate with the Vibration Isolator Manufacturer. Vibration isolation system shall have a maximum lateral motion under equipment start-up and shutdown conditions of 1/4 inch. Restrain excess motion by spring type mountings. Connections to equipment shall allow for deflections.
- B. The Contractor shall coordinate the installation of the vibration isolation devices with all trades and Sub-Contractors. Contractor shall verify with the Architect that the devices and supports are adequate as intended and do not overload the building structural system shall be accepted by the Architect.

3.2 EQUIPMENT CONNECTIONS

- A. No rigid connections between equipment and building structure shall be made that degrades the noise and vibration isolation system herein specified.
- B. Electrical circuit connections to isolated equipment shall be looped to allow free motion of isolated equipment; see Division 26.
- C. Coordinate work with other trades to avoid rigid contact with the building. Inform other trades following work, such as plastering or electrical, to avoid any contact which would reduce the vibration isolation.

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SECTION 23 05 93

TESTING, ADJUSTING AND BALANCING OF MECHANICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED SECTIONS

- A. All Division 22, 23, and 25 specification sections, drawings, and General Provisions of the contract, including General Conditions and Division 1 specifications, apply to work of this section, as do other documents referred to in this section.

1.2 REQUIREMENTS

- A. The testing, adjusting and balancing of the mechanical systems shall be performed by an independent testing and balance (TAB) agency accepted by the Engineer.
- B. The balancing shall be performed by agencies who have been regularly engaged in testing and balancing work for a minimum of five (5) consecutive years and who are certified by the Associated Air Balance Council (AABC) or National Environmental Balancing Bureau (NEBB). The Contractor shall submit the qualifications and experience of all personnel who will be a part of the work group assigned to the project.
- C. The Test and Balance Agency shall not be associated with, or be the same Contractor furnishing the controls or instrumentation unless prior approved.
- D. The Test and Balance Agency shall not be associated with, or be the same company supplying equipment which will be a part of the mechanical systems to be tested or balanced.
- E. The Test and Balance Agency shall furnish all labor, materials, equipment and accessories as required to complete the system balancing.
- F. The Test and Balance Agency shall review the plans and specifications prior to installation of the system and submit a report to the Architect/Engineer of any deficiencies in the system which could preclude proper adjusting, balancing and testing of the system.
- G. The Test and Balance Agency shall inspect the system prior to adjusting, balancing and testing work to insure that all specified components which will affect proper execution of such work are installed and are operating properly including the temperature control system. A report shall be submitted to the Architect/Engineer indicating the results of the inspection.
- H. The Test and Balance Agency shall be in attendance during the testing of the piping and ductwork, and the cleaning and flushing of the water piping. The Test and Balance Agency shall submit a written report on each of these events.
- J. Before final acceptance and after final adjustments have been completed the systems shall be balanced and an operating test performed. Balancing shall not begin until all systems are completed and in full working order. The operating test and training session shall not be performed until the Architect/Engineer has approved the test and balance report.
- K. Applicable requirements in ASHRAE 62.1 - 2004, Section 7.2.2 - "Air Balancing" shall be followed.
- L. Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6.7.2.3 - "System Balancing" shall be followed.

- M. Instrumentation type, quantity and accuracy shall be as described in AABC's "National Standards for Testing and Balancing Heating, Ventilating and Air Conditioning Systems".
- N. Calibrate instruments at least every six months or more frequently if required by the manufacturer. Keep an updated record of instrument calibration that indicates dates of calibration.

1.3 SUBMITTALS

- A. Qualifications: The TAB Agency shall submit a company resume listing all personnel and project experience in air and hydronic system balancing and a copy of the agency's test and balance engineer (TBE) certificate.
- B. Procedures and Agenda: The TAB Agency shall submit the proposed TAB procedures and agenda to be used.
- C. Sample Forms: The TAB Agency shall submit sample forms, which shall include the minimum data required by the AABC's "National Standards for Testing and Balancing Heating, Ventilating and Air Conditioning Systems", or equal NEBB forms.

1.4 TAB PREPARATION AND COORDINATION

- A. The mechanical contractor shall have the system installation complete and equipment start-up complete prior to the TAB Agency's notice to proceed.
- B. The building control system shall be complete and operational. The building control system contractor shall install all necessary computers and computer programs, and make these operational.
- C. Coordinate the efforts of HVAC controls installers and other mechanics to operate the HVAC systems and equipment to support and assist TAB activities. Qualified installation or start-up personnel shall be readily available for the operation and adjustment of the systems.
- D. Perform testing and balancing after leakage and pressure tests on air and water distribution systems have been satisfactorily completed

1.5 WARRANTY

- A. National Project Performance Guarantee: Provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions:
 - 1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
 - 2. Systems are balanced to optimum performance capabilities within design and installation limits.
- B. The testing and balancing firm shall provide a written certificate of guarantee to the Engineer guaranteeing the performance of the balance work to the certification agencies procedures and these specifications. The guarantee shall warrant test repeatability for a period of 90 days from the date of balance. The balance agency shall retest any readings listed in the report as requested by the Engineer within this time period.

1.6 REPORT

- A. Upon completion of all tests, all information shall be included in complete test and balance reports. The final report shall be included in the operating manuals prepared by the Contractor.
- B. Final TAB Report - The TAB agency shall submit the final sealed and signed TAB report for review by the engineer. All outlets, devices, HVAC equipment, etc., shall be identified, along with a numbering system corresponding to report unit identification. The TAB agency shall submit an AABC "National Project Performance Guaranty" assuring that the project systems were tested, adjusted and balanced in accordance with the project specifications and AABC National Standards.
- C. Life Safety Report - The General Contractor shall verify that all smoke control devices are installed and operating properly. After all devices have been proven to be operating properly, make arrangements with Kraemer Consulting Engineers, P.L.L.C (KCE) to test all devices in order to prepare a report on the operation of such devices. The report shall be sealed and signed by KCE, the Engineer of Record. The General Contractor shall compensate KCE for the test and report. Contact KCE for a proposal to perform this service. TAB Contractor shall notify the General Contractor of this requirement.
- D. Ventilation Verification Report - The TAB agency shall include a report showing fresh air compliance for final inspection approval by the mechanical inspector. The report shall verify that the ventilation system is capable of supplying air flow rates required by IMC Section 403. Submit the final sealed and signed report to the Town of Queen Creek Mechanical Inspector and include a copy in the final TAB Report.

1.7 DEFICIENCIES

- A. Any deficiencies in the installation or performance of a system or component observed by the TAB agency shall be brought to the attention of the appropriate responsible person.
- B. The work necessary to correct items on the deficiency listing shall be performed and verified by the affected contractor before the TAB agency returns to retest. Unresolved deficiencies shall be noted in the final report.

PART 2 - PRODUCTS

2.1 EQUIPMENT

- A. The Testing and Balance Agency shall provide not less than the following instruments and equipment for testing and balancing purposes.
 - 1. Pitot tubes and draft gauges.
 - 2. Capture boxes, calibrated.
 - 3. Velometer, calibrated.
 - 4. Thermometers, mercury and bi-metallic stem types.
 - 5. Ampere - voltmeter.
 - 6. Speed Indicator.
 - 7. Calibrated Water Flowmeter.
- B. All instruments used for measurements shall be accurate and calibrated. Calibration and maintenance of all instruments shall be in accordance with National Standards.

PART 3 - EXECUTION

3.1 SCOPE OF WORK

- A. Examine the Contract Documents and provide testing, adjusting and balancing of all HVAC equipment and systems that are part of the project.
- B. The items requiring testing, adjusting, and balancing include, but shall not be limited to, the following:[Edit as required for project.]
 - 1. Air Systems:
 - a. Supply Fans
 - b. Exhaust Fans
 - c. Zone Branch and Main Ducts
 - e. Diffusers, Registers and Grilles
 - f. Coils
 - g. Condensing Units or Condensing Sections
 - h. Smoke/Fire Dampers
 - i. Smoke Detectors
 - 2. Hydronic Systems:
 - a. Pumps
 - b. System Mains and Branches
 - c. Chillers
 - d. Chilled Water Coils

3.2 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. Verify that balancing devices, such as test ports, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- B. Examine approved submittal data of HVAC systems and equipment.
- C. Examine Project Record Documents described in Division 1 Section "Project Record Documents"
- D. Examine equipment performance data including fan and pump curves. 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.
- E. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.
- F. Examine HVAC system and equipment installations to verify that indicated balancing devices such as test ports, flow-control devices, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- G. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
- H. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

- I. Examine strainers for clean screens and proper perforations.
- J. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- K. Examine equipment for installation and for properly operating safety interlocks and controls.
- L. 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.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Complete system readiness checks and prepare system readiness reports. Verify the following:
 - 1. Permanent electrical power wiring is complete.
 - 2. Automatic temperature-control systems are complete and operational.
 - 3. Equipment and duct access doors are securely closed.
 - 4. Balance, smoke and fire dampers are open.
- B. Upon completion of the air conditioning system, the TAB Agency shall perform the below specified tests, compile the test data and submit the complete test data to the Architect.
- C. All information necessary to complete a proper TAB project and report shall be per AABC standards unless otherwise noted. The descriptions for work required, as listed in this section, are a guide to the minimum information needed.
- D. Cut insulation, ducts and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.
- E. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, manual valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.
- F. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 AIR SYSTEMS

- A. The TAB agency shall verify that all ductwork, dampers, grilles, registers, and diffusers have been installed per design and set in the full open position. The TAB agency shall perform the following TAB procedures in accordance with the AABC National Standards:
 - 1. For supply fans:
 - a. Fan speeds - Test and adjust fan RPM to achieve maximum or design CFM.
 - b. Current and Voltage - Test and record motor voltage and amperage, and compare data with the nameplate limits to ensure fan motor is not in or above the service factor.
 - c. Pitot-Tube Traverse - Perform a Pitot-tube traverse of main supply and return ducts, as applicable to obtain total CFM.
 - d. Outside Air - Test and adjust the outside air on applicable equipment using a Pitot-tube traverse. If a traverse is not practical use the mixed-air temperature method if the inside and outside temperature difference is at least 20 degrees Fahrenheit or use the difference between Pitottube traverses of the supply and return air ducts.
 - e. Static Pressure - Test and record system static profile of each supply fan.

2. For exhaust fans:
 - a. Fan speeds - Test and adjust fan RPM to achieve maximum or design CFM.
 - b. Current and Voltage - Test and record motor voltage and amperage, and compare data with the nameplate limits to ensure motor is not in or above the service factor.
 - c. Pitot-Tube Traverse - Perform a Pitot-tube traverse of main exhaust ducts to obtain total CFM.
 - d. Static Pressure - Test and record system static profile of each exhaust fan.
3. For zone, branch and main ducts:
 - a. Adjust ducts to within design CFM requirements. As applicable, at least one zone balancing damper shall be completely open. Multi-diffuser branch ducts shall have at least one outlet or inlet volume damper completely open.
4. For diffusers, registers and grilles:
 - a. Tolerances - Test, adjust, and balance each diffuser, grille, and register to within 10% of design requirements. Minimize drafts.
 - b. Identification - Identify the type, location, and size of each grille, diffuser, and register. This information shall be recorded on air outlet data sheets.
5. For coils:
 - a. Air Temperature Profiles Are Required - Once air flows are set to acceptable limits, take wet bulb and dry bulb air temperatures on the entering and leaving side of each cooling coil. Dry-bulb temperature shall be taken on the entering and leaving side of each heating coil.
 - b. Record refrigerant suction pressure and temperature for refrigerant coils.
 - c. Record air flows and air pressure drop.
9. For condensing units or condensing sections:
 - a. For split system condensing units or condensing sections of packaged units, verify proper rotation of fans. Record compressor data for each compressor. Measure entering and leaving air temperatures.

3.5 HYDRONIC SYSTEMS

- A. The TAB agency shall, as applicable, confirm that all hydronic equipment, piping, and coils have been filled and purged; that strainers have been cleaned; and that all balancing valves (except bypass valves) are set full open. The TAB agency shall perform the following testing and balancing functions in accordance with the AABC National Standards:
 1. For pumps:
 - a. Test and adjust chilled water, hot water, and condenser water pumps to achieve maximum or design GPM. Check pumps for proper operation. Pumps shall be free of vibration and cavitation. Record appropriate gauge readings for final TDH and Block-Off/Dead head calculations.
 - b. Current and Voltage - Test and record motor voltage and amperage, and compare data with the nameplate limits to ensure pump motor is not in or above the service factor.
 2. For system mains and branches:
 - a. Adjust water flow in pipes to achieve maximum or design GPM.

3. For chillers:
 - a. Verify that chillers have been started by others and are in operation. Test and adjust chiller water flows to achieve maximum or design GPM.
 - b. Current and Voltage - Test and record motor voltage and amperage, and compare data with the nameplate limits to ensure compressor motor is not in or above the service factor.
 - c. Test and record temperature profiles of chillers.
4. For coils:
 - a. Tolerances - Test, adjust, and balance all chilled-water and hot-water coils within 5% of design requirements.
 - b. Verification - Verify the type, location, final pressure drop and GPM of each coil. This information shall be recorded on coil data sheets.

3.6 ADDITIONAL TESTING

- A. If initial testing and balancing procedures were not performed during near-peak summer and winter conditions, perform additional testing, inspecting and adjusting during near-peak summer and winter conditions.
- B. The TAB agency shall return and perform additional testing during near-peak conditions at no additional cost.

3.7 OTHER REQUIRED TAB SERVICES

- A. Verification of HVAC Controls:
 1. The TAB agency shall be assisted by the building control systems contractor in verifying the operation and calibration of all HVAC and temperature control systems. The following tests shall be conducted:
 - a. Verify that all control components are installed in accordance with project requirements and are functional, including all electrical interlocks, damper sequences, air and water resets, fire and freeze stats, and other safety devices.
 - b. Verify that all controlling instruments are calibrated and set for design operating conditions.
- B. TAB Report Verification:
 1. At the time of final inspection, the TAB agency may be required to recheck, in the presence of the owner's representative, specific or random selections of data recorded in the certified report. Points and areas for recheck shall be selected by the owner's representative. Measurements and test procedures shall be the same as approved for the initial work for the certified report. Selections for recheck, specific plus random, will not exceed 100- of the total number tabulated in the report.
- C. Kitchen Hood Testing:
 1. The TAB agency shall test and adjust kitchen hood total air flow by duct Pitot-tube traverse if applicable under local code. All sealing of test holes in the exhaust duct to be by others per local code requirements. The TAB agency shall test and record face velocities in accordance with design requirements. It shall test and adjust makeup air flow (if included) to meet design face velocities and pressurization and to minimize turbulence.

D. Ventilation Verification:

1. The TAB agency shall test ventilation air quantities and prepare a report for the *City Building Official* (mechanical inspector) stating that the outside air ventilation is in compliance with the requirements of the International Mechanical Code Chapter 4, Table 403.3, and the mechanical schedules.

E. Duct Leakage Testing:

1. The installing contractor shall isolate and seal sections of ductwork for testing. The test pressures required and the amount of duct to be tested shall be described by the engineer in the appropriate duct classification section. The leakage amount shall not exceed the allotted amount for the pressure class or the allotted amount for that portion of the system, whichever is applicable. All testing shall be based on one test per section only unless otherwise noted.

3.8 OTHER REQUIRED SERVICES PERFORMED BY OTHERS

A. Life Safety Report:

1. The General Contractor shall verify that all smoke control devices are installed and operating. After all smoke control devices have been found to be operating properly, contact the Kraemer Consulting Engineers, P.L.L.C (KCE) to test all devices and prepare a report on the operation of such devices. The General Contractor shall compensate KCE for the test and the report. Contact KCE for a proposal to perform this service. TAB Contractor shall notify the General Contractor of this requirement.
 - a. Testing of smoke detectors, the building smoke detection system, and fire/smoke dampers shall be accompanied by the electrician and/or the control system supplier. If the building has a fire alarm panel, a representative of the manufacturer must be present during the testing and retesting to by-pass the alarms.
 - b. The final test report shall be confirmed, sealed, and signed by Kraemer Consulting Engineers, P.L.L.C (KCE), the signatory engineers on this project. The testing may be performed by KCE or qualified agent of KCE, but not by the installing contractor. Reports signed by individuals, other than KCE, are unacceptable.
 - c. All reports shall contain the following:
 1. Project address including suite number.
 2. Stipulation that activation testing was performed using canned "smoke".
 3. Notation that a related fan shut-down when smoke was sensed at the smoke detector(when applicable).
 4. The Engineer's seal and signature, with the signature over the seal.
 - d. All reports shall contain a summary statement from the Professional Engineer that includes the following:
 1. Notation that the application and installation of all surveyed equipment complies with manufacturer's instructions.
 2. Pressure differential readings at each smoke detector.
 3. The flow velocity range for each installed smoke detector and confirmation that local duct velocity will never exceed these limits.
 4. Location and length of the smoke sensing probe(s) shall be confirmed as being appropriate (where applicable).
 5. A stipulation that each smoke activated element of the system was tested and that each passed.
 6. A detailed air balance report shall be attached when appropriate for confirmation of the designed flow velocities as stipulated in the smoke detector/smoke damper report.

- e. The report shall be furnished to the General Contractor and the City Building Official (mechanical inspector). All discrepancies shall be brought to the immediate attention of the contractor for corrections, then, if uncorrected, to the city mechanical inspector.
- f. The final sealed and signed report shall be submitted to the Owner stating whether the work requiring special inspection was, to the best of the tester's knowledge, in conformance with the approved plans and specifications and the applicable workmanship provisions of this code.
- g. The Report shall be submitted in the Operation and Maintenance Manual.

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SECTION 23 07 00

MECHANICAL SYSTEMS INSULATION

PART 1 - GENERAL

1.1 REQUIREMENTS

- A. Conform with applicable provisions of the General Conditions, Supplementary Conditions and General Requirements.
- B. See Section 23 01 00 for General Mechanical Requirements.

1.2 SCOPE

- A. Domestic hot water piping including circulating hot water, domestic chilled water piping, chilled water supply and return piping, cooling coil condensate drain piping, and refrigerant suction piping.
- B. Ducts, including air conditioning supply air and return air ducts and plenums, and outside air supply ducts and plenums.
- C. Equipment covering.

1.3 TESTING

- A. All piping and ductwork shall be tested and accepted before any insulation is applied.

1.4 FITTINGS

- A. All fittings except as otherwise specified, shall be insulated with the same material and thickness as specified for the pipe.
- B. Unions, flanges and valves on hot water will not require insulation.

1.5 QUALITY ASSURANCE

- A. Qualifications
 - 1. Manufacturer - Company specializing in manufacturing products specified with a minimum 5 years documented experience.
 - 2. Installer - Company specializing in performing the work of this section with a minimum 5 years documented experience.

PART 2 - PRODUCTS

2.1 INSULATION

- A. Insulation shall be as manufactured by Owens-Corning Fiberglass, Gustin-Bacon, Johns-Manville, Manson, or Armstrong, or accepted equivalent, and shall be equivalent to that specified below.
- B. Insulation and all materials on the interior and exterior surfaces of ducts, pipes, tanks, and equipment shall have a composite fire and smoke hazard rating not exceeding: Flame spread - 25; fuel contribution - 50; smoke developed - 50, as determined in accordance with ASTM Standard E-84. Linings in ducts, plenums, and equipment shall meet the Erosion Test Method described in Underwriter's Laboratory Publication No. 181. Insulation shall have a "k" factor of 0.23 at 75 deg. F mean temperature unless otherwise indicated. All insulation materials used for valves and fittings shall have the same ratings as the insulation. Information must be submitted to Architect by means of manufacturer's literature showing that the materials conform to above specification without exception.

2.2 FITTINGS

- A. Fittings, where required to be insulated, shall be covered with fitting mastic reinforced with fiberglass fitting tape and finished to a smooth surface or prefabricated or molded insulation may be used on all fittings where applicable, providing materials meet specified fire and smoke hazard ratings.
- B. Insulation on valves, unions, strainers, 3-way or 2-way control valves and circuit balancing valves, in chilled water systems shall be insulated with preformed insulation enclosure properly sealed at joints so that maintenance and/or inspection of the fitting can be readily achieved and then restored to appropriate insulating condition without destroying the insulation. Seal with non-permeable jacket on chilled water fittings.
- C. Insulate chilled water dirt and air separator same as fittings. Insulate drain lines from the same for a distance of 3'.

2.3 PVC FITTING COVERS

- A. PVC fitting covers may be used for all valves and fittings requiring insulation provided the materials used meet the fire and smoke hazard ratings specified above, and only where the valves and fittings have been wrapped with fiberglass blanket insulation of the same thickness of insulation used on the pipe. Fiberglass blanket shall be held in place with soft copper wire and adhesive applied to the valve or fitting.

2.4 METAL JACKETING

- A. Metal jacket shall be 0.016-inch embossed aluminum backed with a 60-pound kraft vapor barrier. Metal jacketing shall be installed where specified herein or otherwise indicated on the drawings.

PART 3 - EXECUTION

3.1 DOMESTIC HOT WATER PIPING

- A. Domestic hot water piping including recirculating piping shall be insulated with 1-inch thick Fiberglass one-piece preformed pipe insulation with all purpose (ASJ) fire retardant jacket. Fittings shall be finished with fittings mastic reinforced with Fiberglass fitting tape and finished to a smooth surface. Hangers shall be installed under the insulation. Refer to plumbing drawings for insulation for all hot water piping with heat tracer.

3.2 SUCTION DIFFUSERS

- A. Suction diffusers on chilled water pumps shall be insulated with the same insulation materials specified for the piping system, except that means shall be allowed to remove the suction strainers without damaging the insulation.

3.3 CHILLED WATER PIPING

- A. All chilled water piping including valves and fittings and piping connections to expansion tank, dirt and air separator and chemical feeder shall be insulated. Insulation shall be 1" thick for pipes 1-1/2" diameter and under and 1-1/2" thick for pipes over 1-1/2" diameter. Provide 2" thickness for all piping installed outdoors.
- B. All pipes hangers and supports shall be installed outside of the insulation and a 180-degree (half piece, 12" long section of calcium silicate insulation with galvanized steel protection saddle, 14 gauge on pipes over 4") provided at each hanger or support.
- C. All chilled water piping shall be insulated with Fiberglass one-piece or preformed pipe insulation with self-sealed lap all purpose (ASJ) fire retardant jacket. All fittings and valves shall be finished with vapor barrier fitting mastic reinforced with Fiberglass fitting tape and finished to a smooth surface.

3.4 DUCTWORK

- A. All supply air and return air ducts shall be insulated except pre-insulated flexible ducts. See Section 23 30 00 for pre-insulated flexible ducts.
- B. Supply and Return Air Ducts: Except where noted, all supply air ducts and round return air ducts shall be insulated with 2.33" thick, 3/4 lb. density (R = 6.0) Johns-Manville Microlite, FSK facing. The insulation shall be held in place with spot daubing of a quick tacking rubber base adhesive on approximately 6" centers. All end and longitudinal joints shall be butted firmly and the vapor barrier shall be overlapped not less than 2" and sealed continuously with Benjamin Foster 85-20. If staples are used, seal over staples with Childers CP-32, or accepted equivalent. Duct tape shall not be permitted.
- C. Outside Air Ducts: For all outside air ducts connected intake air hoods use the material same as described above in paragraph B except provide 1" thickness (R = 2.9).
- D. Exterior ductwork: All ductwork on the exterior of the building or otherwise exposed to weather shall be insulated internally with 2" thick, 1-1/2 lb. density (R=8.0) duct liner.

3.5 ALUMINUM JACKET

- A. All exposed chilled water supply and return piping, valves and fittings indoors in mechanical rooms and all piping outdoors, including in the chiller yard, shall have insulation covered with 0.016-inch embossed aluminum jacket backed with 60 pound Kraft moisture barrier. Aluminum jacket shall have a 2-inch overlap on longitudinal and circumferential joints. Aluminum jacket shall be secured with 0.020 aluminum bands and clips.

3.6 INSULATION AT VALVES

- A. The termination of all insulation on pipes at valve connections or unions, etc., shall be beveled and finished same as called for on all fittings.

3.7 ACOUSTICAL LINING

- A. Acoustical lining shall be Johns-Manville "Linacoustic RC", or accepted equivalent, with acrylic polymer coating for a smooth airstream surface. All acoustic lining shall have a fire and smoke hazard rating not exceeding: Flame spread - 25; smoke developed - 50. The lining shall be applied using Benjamin Foster 85-20 adhesive and also secured on not more than 16" centers with Stick-Clips (on concrete) or welded pins (on metal) and held with washers not less than 1-1/4" diameter. The acoustic lining shall be installed to completely line the ducts. NRC = 0.85 (min.) for 1-1/2" thickness. Acoustic lining shall be 1-1/2" thick, 1-1/2 lb. density (R = 6.0), unless otherwise specified below.
- B. Ducts must be lined under the following conditions:
1. Where specifically indicated on drawings.
 2. All transfer ducts, and return air boots, use 1" thickness.
 3. Where installed on roof or outdoors, use 2" thickness, (R=8.0).
 4. All rectangular return air ducts upstream of all air handling units and fan coil units, for the entire length.
 5. All rectangular supply air ducts downstream of roof mounted single zone air handling units, for the first 30 feet minimum. The balance shall be lined or wrapped.
 6. All rectangular supply air ducts downstream of fan coil units discharge, for the first 10 feet minimum. The balance shall be lined or wrapped.
 7. All rectangular medium pressure supply air ducts upstream of VAV terminals, for the entire length, unless noted otherwise to be a different material.
 8. All rectangular low pressure supply ducts downstream of all VAV terminal units, for the first 10 feet minimum. The balance shall be lined or wrapped.
 9. Duct sizes are clear inside dimensions. Adjust sheet metal sizes accordingly.

3.8 FACTORY INSULATED EQUIPMENT

- A. Domestic hot water heaters shall be factory insulated.

3.9 APPLICATION

- A. No pipe insulation shall be applied until piping has been pressure tested and accepted. No duct insulation shall be applied until the ducts have been inspected and accepted. All insulation shall be applied in strict accordance with the manufacturer's recommendations.

3.10 PIPE HANGERS

- A. See Section 23 20 00 for requirements concerning protection of insulation at hangers.

3.11 CONDENSATE DRAINS AND REFRIGERANT SUCTION PIPING

- A. Primary condensate drain piping inside the building from fan coil units and other air conditioning equipment, and all refrigerant suction piping shall be insulated for the entire length with flexible closed cell foamed plastic pipe insulation, Armstrong Armaflex, Therma-Cel, IMCOA, or manufacturers named above. Fittings shall be field fabricated of nesting sizes, secured with adhesive. All butt ends and longitudinal joints shall be sealed with adhesive. When exposed to the weather, flexible tubing insulation shall be protected by applying two coats of exterior weatherproof coating as recommended by the manufacturer. Above ceilings, use AP Armaflex with flame spread rating no greater than 25 and smoke development rating or no greater than 50.
1. Use 1" thickness for refrigerant piping.
 2. Use 1/2" thickness for primary condensate drain piping.

END OF SECTION

SECTION 23 20 00

PIPE AND PIPE FITTINGS

PART 1 - GENERAL

1.1 REQUIREMENTS

- A. Conform with applicable provisions of the General Conditions, Supplementary Conditions and General Requirements.

1.2 RELATED SECTIONS

- A. See Section 23 01 00 for General Mechanical Requirements.

1.3 SUBMITTAL DATA.

- A. Contractor shall furnish complete submittal data for all piping materials, including manufacturer's specifications, certifications, class, type and schedule. Submittal data shall additionally be furnished for pipe hangers and supports, seismic restraints, pipe sleeves including sealing and fire safing materials and installation.
- B. Grooved joint couplings and fittings may be shown on drawings and product submittals, and shall be specifically identified by the manufacturer's style or series designation.

1.4 QUALITY ASSURANCE

- A. All pipe and fittings shall be of domestic (U.S.) origin.
- B. All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.
- C. All castings used for coupling housings, fittings, and valve bodies shall be date stamped for quality assurance and traceability.

PART 2 - PRODUCTS

2.1 PIPE AND PIPE FITTINGS

- A. Pipe and pipe fitting material requirements are specified under the sections covering the various piping systems. All welding fittings used in the welding system shall be manufactured by Tube Turns, Inc., Taylor Forge and Pipe Works, Midwest Piping and Supply Co., or Bonney Forge and Tool Works for "Weld-O-Let" or "Thred-O-Let", or accepted equivalent fittings and shall match the pipe in which they are installed. Welding fittings shall conform to ANSI Standards.
- B. All fittings used for welded piping systems shall be Standard ANSI fittings, and shall be of standard pipe thickness. All elbows shall be long radius unless otherwise specified. Wherever tee connections are made in the piping systems, welding sockets (Weld-O-Lets, Thred-O-Lets, or Sock-O-Lets) may be installed for branch connections up to one half the size of the main run, welding tees shall be used on larger sizes. The use of fittings formed from welded pipe sections will not be permitted.

- C. Mechanical pipe couplings and fittings as manufactured by Victaulic or engineer approved equivalent ISO 9001 equivalent manufacturer. All grooved products shall be of one manufacturer and may be utilized for steel piping systems in lieu of butt weld fittings, on applicable piping systems as specified in the applicable Sections of this Specification. All joints shall be listed by ANSI B-31.1, B-31.9, ASME, UL/FM, IAMPO, and BOCA. Couplings shall consist of two ductile or iron housing, with gasket, and ASTM A449 nuts and bolts required to secure the unit conforming to ASTM A-536, Grade 65-45-12. Gaskets shall be molded of synthetic rubber or other compound as recommended by the manufacturer for the fluid application including required pressure and temperature operating ranges, and shall be manufactured by the same company as the coupling housing. Gaskets shall ASTM D-2000.

Couplings shall comply with ASTM F1476 Standard Specification for the Performance of Gasketed Mechanical Couplings for Use In Piping Applications. Couplings shall be:

1. Rigid Type: Coupling housings shall be cast with offsetting, angle-pattern bolt pads to provide joint rigidity and support and hanging in accordance with ANSI B31.1 and B31.9.
 - a. Victaulic Style 107H, Installation-Ready, for direct stab installation without field disassembly, with grade EHP gasket, suitable for water service to +250 deg F.
 - b. Victaulic Style 07 "Zero-Flex"
2. Flexible Type: For applications in conjunction with flexible connections to items of equipment such as pumps, water chillers, air handling units, etc. Victaulic Installation-Ready Style 177 or Style 75 and 77.
3. 14" and Larger: AGS Series, with lead-in chamfer on housing key and wide width FlushSeal gasket. Victaulic Style W07 (rigid) and Style W77 (flexible).
4. Adapter connections between Class 125 and 150 flanged components and grooved piping system shall be made utilizing Victaulic Style 741 and W741 or equivalent flange adapter.
5. Branch and tap connections up to one-half the size of the main may be made utilizing Victaulic Style 72 outlet couplings and Style 920 or 920N branch outlet connections.

Fittings utilized in conjunction mechanical coupling type piping system shall be manufacturer's full flow ductile iron to ASTM A536, wrought steel to ASTM A234, or factory-fabricated steel fittings with grooves designed to accept mechanical couplings. All piping shall be prepared in accordance with manufacturer's specifications, furnished for factory or field installed roll grooves without metal removal. Square cut grooves will not be permitted. Assembly of couplings, fittings and piping shall be in accordance with manufacturer's published instructions. Gaskets, pipe ends, fittings and coupling housings shall be properly lubricated with water-based type lubricant furnished by the coupling manufacturer. The coupling manufacturer's factory trained representative shall provide on-site training for the contractor's field personnel in the use of grooving tools and installation of product. The representative shall periodically visit the job site to ensure best practices in grooved product installation are being followed. (A distributor's representative is not considered qualified to conduct the training.)

2.2 FLOOR, WALL AND CEILING PLATES

- A. Where exposed pipes pass through finished floors, finished walls, or finished ceilings, they shall be fitted with chromium plated spun brass flanges. Plates shall be large enough to completely close the hole around the pipe, and shall not be less than 1-1/2" or more than 2-1/2" larger than the diameter of the pipes. All plates shall be securely held in place.

2.3 UNIONS AND FLANGES

- A. Piping 2-1/2" and larger to have bolted flange unions with gaskets of material suitable for the specified service. Flanges shall conform to Federal Specifications WW-F-406a, Class 125. Ground joint unions with brass to iron seats, conforming to Federal Specification WW-V-531c shall be used in piping 2" and smaller. Unions or flanges shall be installed at all valves and equipment connections.
- B. Unions and flanges for servicing and disconnect are not required in installations using grooved joint couplings. (The coupling shall serve as disconnect point.)

2.4 HANGERS AND ANCHORS

- A. All piping shall be rigidly supported from the building structure by means of vertically adjustable swivel ring clevis type hangers suspended on threaded steel rods. Where pipes run side by side, support on rod and angle iron, or unistrut, trapeze hangers. Cast iron soil waste and vent piping shall have hangers not more than one foot on each side of every change in direction and 2'-6" on each side of every change in direction for all other piping. Piping system shall be installed in an approved manner and shall not overload the building structural frame. Contractor shall provide additional hangers and steel members as may be required to distribute the piping system load over several structural members where required or directed. Ellen, Fee and Mason, Grinnell, Michigan, and Superior are acceptable manufacturers.

Maximum allowable spacing shall be as follows:

<u>Steel Piping</u>	-	<u>Maximum Spacing</u>
1/2"	-	6'-0"
3/4" through 1-1/4"	-	8'-0"
1-1/2" through 2-1/2"	-	10'-0"
3" through 12"	-	12'-0"
<u>Copper Piping</u>	-	<u>Maximum Spacing</u>
1/2"	-	6'-0"
3/4", 1"	-	8'-0"
1-1/4" through 2"	-	10'-0"
2-1/2" and above	-	12'-0"
<u>Cast Iron Piping</u>	-	<u>Maximum Spacing</u>
3"	-	1 ea. joint
4" and 5"	-	1 ea. joint
6"	-	1 ea. joint

The above spacing is the general case. Do not exceed the loading allowance on the structure. Reduce the hanger spacing in order to meet the loading allowance as required.

- B. Round rods supporting the pipe hangers shall be of the following dimensions:

<u>Steel Piping</u>	-	<u>Hanger Rod size</u>
1/2" through 2"	-	3/8"
2-1/2", 3"	-	1/2"
4", 5"	-	5/8"
6"	-	3/4"
8" through 12"	-	7/8"
<u>Copper Piping</u>	-	<u>Hanger Rod size</u>
1/2" through 2"	-	3/8"
2-1/2" through 5"	-	1/2"
6" and above	-	3/4"
<u>Cast Iron Piping</u>	-	<u>Hanger Rod size</u>
3"	-	1/2"
4" and 5"	-	5/8"
6"	-	3/4"

- C. Hangers for copper tubing shall be insulated from the tubing or hangers shall be of copper construction. Rods for trapeze hangers shall be a minimum of 3/4" and shall have the equivalent cross section listed above per pipe supported. The use of pipe hooks, chains, or perforated iron for pipe supports will not be permitted. Chilled water piping shall have hangers installed outside insulation and a 180-degree, 12" long section of calcium silicate insulation with galvanized steel protection saddle (18 gauge on pipe through 4" and 14 gauge on pipe over 4") provided at each hanger or support, or thermal hanger shields as manufactured by Pipe Shields, Inc. Contractor shall provide a 8" long, 14 gauge galvanized steel protection saddle for all insulated pipes where pipe is resting on hangers, trapeze, unistrut, or other similar support structure. The Contractor shall provide inserts in the building construction at the time the concrete is poured, and the hangers shall be attached to these inserts. Where inserts cannot be used, expansion shields may be used provided the hanger is not attached rigidly to the bolt but is supported from an angle held in place by the expansion bolt. Anchors and guides shall be provided where required for proper control of expansion and contraction.
- D. Attachment of piping hangers to the building structure shall be provided in a manner accepted by the Architect. When hanging from steel structure, use concentrically loading beam clamps. The use of eccentrically loading "C" clamps is prohibited.

2.5 CONDENSATE DRAIN PIPING

- A. Condensate drain piping shall be ASTM B-88, Type "M" hard drawn with wrought copper fittings and soldered joints, 50/50 solder.
- B. The Contractor shall extend condensate drain lines from all air conditioning equipment as shown on the drawings.
- C. The Plumbing Contractor shall install a tail piece with a condensate drain connection as required by the mechanical drawings for condensate piping which ties into a lavatory tail piece. The Mechanical Contractor shall coordinate this requirement with the Plumbing Contractor.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

- A. Provide and erect, in a workmanlike manner, according to the best practices of the trade, all piping shown on drawings and required for the complete installation of these systems. The piping shown on the drawings shall be considered as diagrammatic for clearness in indicating the general run and connections, and may or may not in all parts be shown in its true position. The piping may have to be offset, lowered or raised as required or as directed at the site. This does not relieve the Contractor from responsibility for the proper erection of systems or piping in every respect suitable for the work intended as described in the specifications and accepted by the Architect. In the erection of all piping, it shall be properly supported and proper provisions shall be made for expansion, contraction and anchoring of piping. All piping shall be cut accurately for fabrication to measurements established at the construction site. Pipe shall be worked into place without springing and/or forcing, properly clearing all windows, doors, and other openings and equipment. Cutting or other weakening of the building structure to facilitate installation will not be permitted. All pipes shall have burrs and/or cutting slag removed by reaming or other cleaning methods. All changes in direction shall be made with fittings. All open ends of pipes and equipment shall be properly capped or plugged to keep dirt and other foreign materials out of the system. Plugs of rags, wool, cotton waste or similar materials may not be used in plugging. All piping shall be arranged so as not to interfere with removal and maintenance of equipment or filters or devices; and so as not to block access to manholes, access openings, etc. Flanges or unions as applicable for the type of piping specified shall be provided in the piping at connections to all items of equipment including refrigeration machines. All valves and specialties shall be so placed to permit easy operation and access, and all valves shall be regulated, packed and adjusted at the completion of the work before final acceptance. All piping shall be erected to ensure proper draining. Water piping may be run level but shall be free from traps.

3.2 JOINTS

- A. Screwed Joints: Shall have American Taper pipe threads. Ream pipe ends and remove burrs after threading. Make up joints using Teflon tape or other approved compound applied to the male threads only.
- B. Solder Joints: Tubing shall be cut square and burrs removed. Both inside of fittings and outside of tubing shall be well cleaned before sweating. Care shall be taken to prevent annealing of fittings and hard drawn tubing when making connections. Joints for sweated fittings shall be made with a non-corrosive paste flux and solid 95-5 wire solder, unless otherwise specified. Cored solder or any solder containing lead will not be permitted.
- C. Welded Joints: On black steel piping 2" and above in size, the joints may be welded. Welding shall be done using either gas or electric welding equipment. Certified welders shall be used. Welders shall be certified in accordance with Section IX of ASME Boiler and Pressure Vessel Code, latest edition. All pipe surfaces shall be thoroughly cleaned before welding. Each joint shall be beveled before being welded. Piping shall be securely aligned and spaced, and the width of the circumferential welds shall form a gradual increase in thickness from the outside surface to the center of the weld. All fittings used in the welded piping systems shall be standard ANSI fittings, and shall be of standard thickness. The Contractor shall provide non-combustible mat or blanket to protect the structure and adequate fire protection at all locations where welding is done. The use of fittings formed from welded pipe sections will not be permitted.
- D. Insulating Fittings: Insulating fitting shall be used to connect dissimilar metals (such as steel and copper) to prevent electrolytic action. Insulating fittings will not be required between bronze valves and steel pipe, or between copper coil headers and steel pipe.
- E. Flanged Joints: Flanged joints shall conform to the American Standard for cast iron flanged pipe fittings, Class 125 (B.16.1- 1948). Gaskets shall be suitable for the service on which used.
- F. Mechanical Joints: See paragraph 2.1 C. for requirements. Grooved joint shall be installed in accordance with the manufacturer's written recommendations. Grooved ends shall be clean and free from indentations, projections, or roll marks. The gasket shall be molded and produced by the coupling manufacturer of an elastomer suitable for the intended service. The coupling manufacturer's factory trained representative shall provide on-site training for the contractor's field personnel in the use of grooving tools and installation of product. The representative shall periodically visit the job site to ensure best practices in grooved product installation are being followed. A distributor's representative is not considered qualified to conduct the training.

3.3 PUMP AND EQUIPMENT CONNECTIONS

- A. All piping connecting to pumps or other equipment whether connected utilizing flexible connectors or with solid pipe connectors, shall be installed without strain at the pipe connection of this equipment. The Contractor shall be required to demonstrate that piping has been so connected.
- B. Three grooved joint (Victaulic) couplings may be used in lieu of a flexible connector at equipment connections to accommodate vibration attenuation and stress relief. The couplings shall be placed in close proximity to the source of the vibration.

3.4 FLEXIBLE CONNECTIONS

- A. Provide flexible connectors at locations indicated on the drawings. Flexible connectors shall be Mason type SFEJ, SFDEJ, or SFU, or equivalent by Twin City Hose. Special care shall be exercised to provide adequate support of piping to eliminate any strain on the flexible connectors.

3.5 PIPE SLEEVES

- A. Piping will not be permitted to pass through footings, beams or ribs except where written consent of the Architect. Pipe sleeves shall be installed and properly secured in place at all points where pipes pass through concrete or masonry construction and steel decks. Pipe sleeves shall be cast iron soil pipe and shall be of sufficient diameter to provide ½" minimum clearance around the pipe, and in cases of insulated pipes, 1/2" minimum around the insulation. Pipe sleeves in footings and beams shall be of steel pipe. Sleeves in footings shall be not less than 1" or more than 2" larger in diameter than the pipe to be installed. Pipe sleeves in floors shall extend 2" above finished floor in toilets or rooms where domestic water is used. Openings between piping sleeves shall be made watertight with plastic cement to a minimum depth of 2". In addition, openings between piping and sleeves in all masonry, concrete interior walls or gypsum board fire walls and partitions shall be tightly sealed to prevent gases from passing through the pipe sleeves in the event of fire. Where pipes pass through exterior walls, the annular space between the wall and the pipe shall be sealed by sealing elements made of synthetic rubber, pressure plates, and cadmium plated bolts equivalent to Link- Seal LS-300 up to 10" pipe size larger than carrier line.

3.6 EXPANSION AND CONTRACTION

- A. For water systems, Victaulic flexible couplings may be used on header piping to accommodate thermal growth and contraction, and for the elimination of expansion loops, as approved by the engineer. Where loops are required, use flexible-type couplings on the loops.

3.7 PROTECTIVE COATINGS

- A. All underground steel pipe shall be wrapped with "Scotchwrap" No. 50 tape to give not less than two complete layers on the entire underground piping system, or piping shall have X-Tru-Coat factory applied plastic protective covering.

3.8 TESTING

- A. Before any insulation is installed or before piping is covered or enclosed, all piping systems shall be tested and proven tight at not less than the maximum service pressure which the piping systems will be required to handle, unless otherwise specified. All tests shall be witnessed and accepted by the Architect or his authorized representative.
- B. Tests shall not be used to establish pressure ratings.
- C. Protect all piping and equipment against overpressure, collapse from vacuum, and hydraulic shock during the filling, testing and draining procedures. Seats of iron valves shall not be subjected to a pressure in excess of the maximum cold working pressure of the valve. Pressure tests against other closed valves shall not exceed twice the normal rating.
- D. Apply test pressure only after the system and test medium are at approximately the same temperature, preferably not less than 60°F. Note that some applicable codes may require testing above a specified minimum temperature.
- E. Remove from the system all pumps, turbines, traps, expansion joints, instruments, control valves, safety valves, rupture discs, orifice plates, etc., which might be damaged by the test, or are designated by the Architect.

3.9 FLUSHING, DRAINING, AND CLEANING PIPE SYSTEMS

- A. The Contractor shall flush out all water systems with pre-start-up cleaner before placing them in operation to remove all oil and foreign material from piping and equipment. Other systems shall be cleaned by blowing them out with compressed air or nitrogen. After systems are in operation and during the test period, all strainer screens shall be removed and thoroughly cleaned.
- B. Coordinate with the Water Treatment Sub-contractor to supply sufficient pre-start-up cleaner for flushing and cleaning of systems to remove all oil and foreign matter from piping and equipment.
- C. This contractor shall clean all strainers after initial flush, after cleaning flush, and prior to start-up.
- D. Cleaning of pipelines shall be witnessed by the TAB Agency.

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SECTION 23 23 00

REFRIGERANT PIPING SYSTEM

PART 1 - GENERAL

1.1 REQUIREMENTS

- A. Conform to the applicable provisions of the General Conditions, the Special Conditions and the General Requirements.
- B. Refrigerant piping accessories associated with Kitchen Equipment furnished under other sections of this specification shall be furnished and installed by the Equipment Sub-Contractor.

1.2 RELATED SECTIONS

- A. See Section 23 01 00, General Mechanical Requirements.
- B. See Section 23 20 00, Pipe and Pipe Fittings.
- C. See Section 23 07 00, Mechanical Insulation.

1.3 SCOPE

- A. The Contractor shall furnish and install the complete refrigerant piping system as shown on the drawings, and as recommended by the equipment manufacturer.
- B. The work included in this contract consists of furnishing all labor, materials, equipment, tools and services, and includes all costs whatsoever which may be required to completely install and place in operation the systems described herein.
- C. Furnish and install all concrete, grout, and other required materials to fill all blockouts and/or sleeves left open for the Contractor's convenience, or for the installation of this work.

1.4 QUALITY ASSURANCE

- A. All pipe and fittings shall be of domestic (U.S.) origin.

PART 2 - PRODUCTS

2.1 AIR COOLED CONDENSER

- A. Furnish and install air cooled condensers located on building roof as shown on the drawings. Air cooled condenser shall be of type and capacity as specified in the Mechanical Equipment Schedule on the drawings. See Section 23 30 00 for detailed description.

2.2 PIPING

- A. Refrigerant piping materials and installation shall be in accordance with the best working and piping practices for Freon refrigerants. The Contractor shall install the refrigerant piping using ACR seamless, ASTM B-88 copper tubing, hard drawn, Type "L" in the buildings, above ground, capped and nitrogen pressurized, with silver solder joint. All piping shall be installed in a straight manner, free from traps, and shall be provided with plugged or capped ends, as it is erected, to prevent dirt from entering. The piping system shall be provided with gauges as required for the operation of the system. Provide the piping from the indoor units to the outdoor units complete. Verify the exact piping arrangement and pipe sizing with the equipment manufacturer.

- B. During erection and making the silver soldered or sil-fossed joints in the piping system, a constant purge of inert gas shall be injected into the system to prevent formation of copper oxide on the inside of the piping system. Inert gas may be either nitrogen, argon, or other similar gas.
- C. A complete refrigeration piping diagram shall be submitted for approval before any installation of the piping system is begun. The submittal shall show complete material list of items to be field installed including joining material, pipe, fittings, inert gas to be used for purge, method of evacuation, pipe sizing, valves, driers, solenoid valves, thermostatic expansion valves, charging and evacuation connections, and refrigerant charge required. The submittal shall also show the major items of equipment: chillers, condensers, receivers, etc., and the factory connections to them.

2.3 VALVES

- A. Expansion valves shall be of the thermostatic type as manufactured by Alco, Sporlan, or accepted equivalent, and shall be gas charged with capillary tube, external superheat adjustment and external equalizing connection. The expansion valves at each apparatus shall be protected by a strainer in the refrigerant liquid line to that group. The strainer shall be as manufactured by the Henry Valve Company, or accepted equivalent, not less than line size and provided with shut-off valves before and after, and furnished with the packaged reciprocating unit.
- B. Solenoid valves shall be suitable for the system in which they are used and shall be designed specifically for use with Freon refrigerants. Solenoid valves shall be furnished with the packaged reciprocating unit.
- C. Refrigerant line valves shall be packless type or packed type with gas tight cap seal with wheel, globe, angle, or "T" needle type, with hard metal seats and shoulders on stems to permit packing stuffing boxes while open under pressure, or sealed diaphragm type.

2.4 DRYER

- A. In each liquid line, install a suitable silica gel filter and dryer. Dryer shall be furnished with the chiller.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Piping installation shall conform to the requirements of Section 23 01 00, General Mechanical Requirements and Section 23 20 00, Pipe and Pipe Fittings.
- B. Installing mechanical contractor shall coordinate refrigerant piping requirements (sizing, accessories, etc.) with manufacturer and assume responsibility and cost for required items.
- C. Unit manufacturer shall provide, in writing, a guarantee of design performance and warranty for all systems. The refrigerant piping lengths shall be confirmed and included in letter of guarantee.

3.2 TESTING OF REFRIGERANT PIPING SYSTEM

- A. After the installation of the refrigerant piping system has been completed, all pipes shall be tested and proven tight for a period of 24 hours at a pressure of 300 lbs. per square inch using dry nitrogen. The Testing and Balancing Agency shall certify in writing that all tests were satisfactorily completed before the piping was concealed and shall submit the certification to the Architect.

3.3 EVACUATION AND CHARGING

- A. Upon completion of the piping pressure test, the refrigerant circuit shall be evacuated to 500 microns absolute using a closed tube manometer and a Beach-Russ, or equivalent, high vacuum pump to ensure tightness of the piping and to remove air and moisture from the piping system. Upon completion of evacuation and acceptance of the system tightness, the vacuum shall be broken by the introduction of the refrigerant.

3.4 REFRIGERANT AND LUBRICATING OIL

- A. Contractor shall furnish and install all of the refrigerant required to develop the system to its full rating, and in addition to the initial charge, shall be required to provide all refrigerant required for the proper operation of the refrigeration apparatus during the first season's operation. Contractor shall guarantee that the loss of refrigerant for a season's operation shall not exceed 10% of the full charge of the system and he shall furnish any refrigerant required above this amount. This guarantee shall remain in effect until such time as the Contractor shall demonstrate this performance for one full year's operation. The Contractor shall be required to provide the initial charge of lubricating oil for all refrigeration apparatus and related equipment, and shall furnish a chart listing the type of oil and a schedule for maintenance that should be used with the various equipment.

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SECTION 23 30 00

AIR-TEMPERING SYSTEM

PART 1 - GENERAL

1.1 REQUIREMENTS

- A. Conform with applicable provisions of the General Conditions, the Special Conditions and General Requirements.
- B. See Sections 23 01 00, 23 20 00, 23 23 00, 23 60 00, 23 62 00, 23 90 00, 25 00 00 for general mechanical requirements and related work.

1.2 WORK SPECIFIED ELSEWHERE

- A. Insulation and Acoustical Treatment are specified under Section 23 07 00.
- B. Painting of equipment is covered under "Painting" in these specifications.
- C. Electrical Work as noted in Section 23 01 00, "General Mechanical Requirements".
- D. Duct Chases, Wall Openings and Equipment Foundations by General Contractor.
- E. Building Automation System is specified under Section 25 00 00.

1.3 SCOPE

- A. Furnish and install central station air handling units, variable air volume terminals, mini-split system heat pump units, fan coil units, fans, wall mounted electric heaters, filters, intake air and relief air hoods, sheet metal work, volume dampers, grilles, diffusers and registers, louvers, fire dampers and sleeves, roof curbs, accessories and incidentals.
- B. Rough-in and connect exhaust connections on all equipment requiring exhaust.

1.4 SOUND LEVELS

- A. Sound levels attributable to mechanical equipment such as terminal units, fan-coil units, centrifugal fans, etc. are designed to result in sound levels of NC 35 for offices, NC 30 for classrooms and conference rooms, NC 25 for auditoriums, etc. measured within the rooms. Sound levels are designed to meet acoustical levels and design per the project acoustical engineer. Mechanical equipment that has been substituted for the specified equipment shall perform within these sound limitations, or will be replaced or adjusted as required. Sound levels attributable to duct vibration that result in noticeable noise or vibration to duct hangers, lighting fixtures, ceiling tees or diffusers shall be adjusted and supported until the disturbing noise is brought within acceptable limits.

1.5 DIMENSIONS

- A. The Contractor shall check all drawings furnished upon their receipt and shall promptly notify the Architect of any discrepancies. The Contractor shall compare all drawings and verify all dimensions both on the drawings and in the field before laying-out, cutting, and fabricating the work. Sheet metal work that is cut and fabricated from the Contract Drawings without dimensional verification will be at the risk of the Contractor.

PART 2 - PRODUCTS

2.1 EQUIPMENT SCHEDULES

- A. The capacities of all major items of equipment are specified in the Equipment Schedules on the drawings and shall be furnished complete with all accessories normally supplied with the catalog item listed and all other accessories necessary for a complete and satisfactory operating system. Detailed descriptions of all major items of equipment are included in the related sections of specifications.

2.2 DUCTWORK

- A. Materials: Construct all ducts, casings, plenums, etc. from new hot-dipped galvanized steel sheets, ASTM A-653. Sheets shall be free of blisters, slivers, pits, and imperfectly galvanized spots. Reinforcing angles and bars, and duct support materials shall be galvanized steel. Construct and erect ductwork in accordance with the latest issues of SMACNA Standards and ASHRAE Guide. Comply in the Fabrication of joints, seams, bracings, reinforcement, hangers, fittings, housings, casings and special applications.
- B. All low velocity air conditioning supply air and return air ductwork to be 2-inch duct construction. Duct classified shall be in accordance with SMACNA Table 1-1.
- C. Round ductwork shall be spiral lock seam with factory fabricated fittings.
- D. All low velocity exhaust ductwork, except special ductwork specified herein, shall be fabricated to 1-inch duct construction.
- E. Sealing shall be as required in the SMACNA Duct Construction Standards for construction pressure classes. Sealant shall not exceed a flame spread of 25 or a smoke development of 50, and shall be UL certified for flame spread and smoke development.
- F. Low velocity supply air, return air and outside air ductwork, and all exhaust air ductwork, except kitchen hood ductwork, shall have both longitudinal and traverse joints sealed with "Hardcast", or with high velocity sealer. Duct leakage as measured by summing CFM at individual registers shall be limited to 1% of the flow rate (CFM) measured at the fan. Exhaust and return air registers leaking at the ceiling joint, where air is being drawn from the ceiling cavity instead of being exhausted from the room, shall be sealed with high velocity duct sealer.

2.3 FLEXIBLE DUCTS

- A. Casco Silentflex II for low pressure, acoustical flexible ducts, or prior-approved equivalent. Factory fabricated assembly, spiral construction, fiberglass blanket insulation, and spun-bonded non-woven nylon liner. Flexible ducts shall maintain dimensional integrity and shall be designed for the duct pressures encountered. Pressure rating shall be for 1-1/2 times the duct pressure at the connection. Flexible ductwork insulation shall have an "R" value of 6.0 minimum. Flexible ductwork shall meet U.L.181 as a Class I air duct and not exceed a flame spread rating of 25 or a smoke development rating of 50. Flexible ducts shall be a minimum of 5 ft. in length but not exceed 8 ft. in length.
- B. Install flexible ducts with a minimum of bends, and extended straight where possible. Minimum bend radius shall be 1-1/2 times the diameter of the duct measured from the centerline. For connections at diffusers or other low pressure applications shall be sealed and connected with stainless steel worm drive clamps.
- C. Round connections to rectangular ducts shall be made with either spin-in fittings or 1/2" flanged bottom taps as described under Air Control Dampers.

- D. Flexible ducts for connections between medium or high velocity ductwork and high pressure terminal units shall be a high pressure type capable of holding 6" W.C. of static pressure with dimensional stability and without developing leaks, and shall be equivalent to Thermaflex Type M-KC. Installation of flexible duct shall ensure that the inside radius of bends shall not be less than the duct diameter.

2.4 FIRE DAMPERS

- A. At the locations shown on the drawings, provide fire dampers. Provide access doors at all fire damper locations of sufficient size to allow easy inspection and resetting of fire damper linkages. Fire damper links shall be of the test strength recommended to prevent nuisance closing. All fire dampers shall conform to the requirements of NFPA Pamphlet 90A, and shall bear the Underwriter's Label. All fire dampers shall be furnished with sleeves. Fire dampers shall be installed inside the fire walls and supported as required by UBC and NFPA 90A.
- B. High Velocity Round or Oval Fire Dampers: High velocity fire dampers shall be of the folding blade type with the hinged damper blades completely out of the air stream so as to cause a minimum of static pressure drop. Fusible links shall be accessible from either side of the damper. Each damper shall be furnished complete with a galvanized welded steel sleeve (round or oval) and closure compartment to house the folded blades of gauges allowed by UL 555.
- C. Rectangular Fire Dampers: Fire dampers for rectangular ductwork shall be of the folding blade type with the hinged blades completely out of the air stream or of the single hinged blade type. Fusible links shall be accessible from either side of the damper. Each damper shall be furnished with a U.L. approved galvanized welded steel sleeve and closure compartment to house the folded blades as allowed by UL 555.

2.5 SMOKE DAMPERS

- A. Smoke dampers shall be installed in walls designed as smoke partitions. Dampers shall be tight closing interconnected multi-blade type with shaft extension for external operation by pneumatic or electric motor. Smoke dampers shall be located as near as possible to the smoke wall and always within ductwork before any cross duct joints.

2.6 SMOKE/FIRE DAMPERS

- A. Smoke/Fire Dampers: Where both fire and smoke dampers are required in the same wall, the Contractor may furnish and install fail-safe combination fire and smoke dampers with a minimum Class II leakage rating where shown on the drawings and at every duct and return air penetration of walls so designated as fire and smoke walls. Combination fire and smoke dampers shall be UL555S labeled fire damper with fusible link and with auxiliary operating shaft permitting operation of damper by standard electric damper operators. Operation of unit shall be such that if fusible link melts, the damper is disconnected from auxiliary shaft and damper closes and latches and functions as a fire damper. Operation of the unit as a smoke damper is such that upon detection of smoke by the Building Fire Detection System, designated smoke dampers are automatically closed by de-energizing electric or pneumatic damper motors. Dampers shall have frames constructed of 16 ga. steel, 16 ga. steel blades 6" wide and 6" on centers with closure spring, stainless steel bearings.
- B. In addition to the leakage ratings already specified herein, the smoke dampers and their electric actuators shall be qualified under UL555S to an elevated temperature of 350 degree F and shall be power open-fail close. Appropriate actuators shall be installed by the damper manufacturer at time of damper fabrication. Damper and actuator shall be supplied as a single entity which meets all applicable UL555S qualifications for both dampers and actuators. Damper and actuator assembly shall be factory cycled 10 times to assure operation. All wiring or piping material required to interconnect the actuator with detection and/or alarm or other systems shall be furnished by others as detailed elsewhere in the specification. 120 volt or 24 volt, verify with the electrical and fire alarm contractor.

2.7 AIR CONTROL DAMPERS

- A. Automatic Dampers: Dampers shall be low leakage or high velocity low leakage as specified in the sequence of operations. All proportional dampers shall be opposed blade type. Two position dampers may be opposed or parallel blade type. Damper frames and blades shall be galvanized steel and a minimum of 16 gauge. Blade width shall not exceed 8 inches. Dampers and seals shall be suitable for temperature ranges of -50 to 250 degrees F. Damper linkage hardware shall be constructed of aluminum or corrosion resistant zinc and nickel plate steel. Dampers shall be low leakage equipped with neoprene edge seals and compressible metal jamb seals. Leakage shall not exceed 10 CFM/sq.ft. at 4" W.G. differential. Damper manufacturer shall supply alignment plates for all multi-section dampers. Damper operators shall be electric and are provided in the control system suppliers work. Dampers shall be Ruskin, Model CD36 or equal.
- B. Manual Volume Dampers: Dampers shall be opposed or parallel blade type. Damper frames and blades shall be galvanized steel and a minimum of 16 gauge. Blade width shall not exceed 8 inches. Dampers and seals shall be suitable for temperature ranges of -50 to 250 degrees F. Damper linkage hardware shall be constructed of aluminum or corrosion resistant zinc and nickel plate steel. Round dampers shall have single blade with reinforced galvanized frame. Damper operators shall have manual locking quadrants. Where ducts are insulated, the hand quadrant shall be extended 2" away from the frame.
- C. Round Take-Offs From Rectangular Ducts: Diffuser and grille take-offs from rectangular ducts to round ducts shall be made with either a spin-in fitting or a ½" flanged bottom tap. Round take-offs shall be built from 26 gauge galvanized steel with a 24 gauge round damper blade and locking quadrant with 2" stand off to allow for insulation thickness. Damper blades shall be secured in set position with wing nuts. Round take-offs 13" diameter and larger shall be supplied with a solid rod and nylon bushings. Reference figure 7-4 of the 2005 edition of the SMACNA HVAC Duct Construction Standards.

2.8 ACCESS DOORS

- A. Wall, ceiling and duct access doors at fire dampers shall be Controlair 16-ga. access door with continuous hinge, gasket and thumb screw locks. Baked aluminum enamel finish on access door on finished surfaces. Size of fire damper access doors in low velocity ductwork shall be 2" less than the width of the duct by 12", up to a maximum size of 12" x 24". Access doors on insulated ductwork shall be installed on an extended metal collar flush with the insulation.
- B. Units shall have gaskets and close airtight. Metal doors in ducts lined with acoustical insulation shall be lined with the same thickness of acoustical insulation as the duct.
- C. Plenum Access Doors: As indicated on the drawings, or required for proper access to fan plenum spaces, etc., provide and install sheet metal access doors of the size as noted or as required for proper access to the equipment. These doors shall be constructed of No. 22 gauge metal and shall be as sized on the drawings. Doors shall be provided with a flat iron or angle iron stiffening frame and so constructed that they can be operated without twisting or distortion. Doors on insulated ductwork shall be of double panel construction provided with an approved insulated filler not less than insulation thickness of the plenum of duct. The duct opening at each door shall be provided with a continuous reinforcing galvanized bar or angle against which the door will close, this being provided with a sponge rubber gasket to make the door airtight. Door frames on insulated ductwork shall be placed on an extended metal collar flush with the face of the finished insulation. All parts of the door shall be constructed of galvanized iron and shall be airtight. Provide signs for access doors "CAUTION - SHUT OFF FANS BEFORE ENTERING" on return air, outside and supply air plenums and ducts. Latches shall be "Ventlok" No. 310.

2.9 ACOUSTICAL LINING

- A. The acoustical lining shall be as specified in Section 23 07 00, Mechanical Systems Insulation. The acoustic sheets shall be installed to completely line the plenum walls and roof. After acoustic sheets have been installed, all joints shall be pointed up to a smooth surface with asphalt emulsion.

2.10 LOUVERS

- A. Louvers shall be storm proof design constructed of .081" extruded aluminum, unless noted otherwise. Extruded blades shall be inclined at least 25 degrees from the horizontal. Slats over 48" long shall have internal intermediate supports. The exterior face of the louver shall have a flange all around, neatly fitted to the building wall, flashed at top and caulked at sides and bottom. Net open area for air passage shall be a minimum of 50% of the nominal size. On the inside face of each louver, install a removable screen, consisting of 1/2" mesh galvanized wire screen in a galvanized channel frame. Refer to the Architectural and Mechanical drawings for louver requirements. Stationary louver pressure drop shall not exceed 0.06", and shall carry less than 0.3 ounces of water per square foot when tested in accordance with AMCA Standard 500.
- B. Contractor must coordinate louver size and construction with Structural and Architectural openings to assure proper fit.

2.11 FILTERS

- A. Filters shall be as listed in the schedules on the drawings. Three (3) set of filters are required. Provide two (2) sets of specified filters for each piece of equipment. Install one (1) set of specified filters just prior to final testing and balancing, and install one (1) set of specified filters upon owner occupancy, or as directed by the owner. During construction furnish and install one (1) set of temporary filters to protect the equipment. Temporary filters may be throwaway filters in lieu of the specified filters.

2.12 FILTER GAUGE

- A. Furnish and install a filter gauge for each bank of filters. Gauges shall be magnahelic type with static pressure tips and inter-connecting piping. Ranges shall be 0-1" W.G. for all filters except bag filters which have a range of 0-2" W.G.

2.13 TURNING VANES

- A. Turning vanes shall be installed in all square elbows in low velocity supply and exhaust ductwork. Turning vanes shall be high efficiency profile type.
- B. Furnish airfoil shaped acoustical turning vanes designed to reduce the dynamic air losses as well as the noise level. Turning vanes shall be non-corrosive and shall have fiberglass fill with open protective metal facing. Furnish galvanized steel mounting rails with prepunched locating holes on 3-1/2" centers designed to receive the turning vanes the full width or height of the duct. All square elbows shown on the supply ducts on the drawings shall incorporate acoustical filled turning vanes.

2.14 COILS

- A. Heating and cooling coils shall be ARI certified design and manufacture. In no case shall specified air or water pressure drops be exceeded more than 10 percent. Piping connections shall be as shown on the drawings. Coils shall be as specified in the equipment schedule on the drawings. In no case shall rows or fin spacing be less than the minimum surface scheduled.

2.15 GRILLES, DIFFUSERS, AND REGISTERS

- A. Grilles, Diffusers, and registers shall be fabricated of steel or aluminum. Aluminum only shall be used in areas of high moisture content, such as shower and locker rooms. Steel grilles, diffusers, and registers shall receive a zinc phosphate prime coat and a baked enamel finish. Aluminum grilles, diffusers, and registers shall also be finished in a baked enamel finish. The type of grille, diffuser, and register is shown by symbol number on the drawings. All symbol numbers shall be cross checked against the Architectural Room Finish Schedule which shall govern in the event of a conflict; discrepancies shall be clearly noted on the submittals. Furnish additional t-bars as required to support and finish around ceiling mounted diffusers and grilles. Provide sponge rubber gasket around frame on all surface mounted supply diffusers, registers, and grilles. Equipment manufactured by Carnes, Krueger, Titus and Price or equivalent. Ductwork run-outs connecting diffusers with round necks shall be the same size as the diffuser neck, unless otherwise noted. All grilles, diffusers, and registers shall be ADC (Air Diffusion Council) certified and rated in accordance with the ADC Equipment Test Code.

2.16 SMOKE AND FIRE DETECTORS

- A. The air duct fire detector units shall be Pyrotronics Combination Photo-Electric/Ionization or equivalent. They shall be listed by Underwriter's Laboratories, Inc. The units shall be designed for detection of combustion gases, fire and smoke in air conditioning and ventilation system ducts, in compliance with the National Fire Protection Association, Recommended Practices Pamphlet No. 90A. It shall consist of a Pyrotronics ionization type detector with self-contained control unit. The assembly shall consist of a casting to accommodate sampling tubes which extend across the duct of the ventilation system. While the fans are operating, a continuous cross-sectional sampling of air from the duct will flow through the ionization detector, after which the sampled air shall be returned to the duct. System shall be 24 VAC or 120 VAC and be compatible with the building fire alarm system as specified in Divisions 26, 27, or 28 of this specification.
- B. The unit shall provide the following functions:
1. Furnish necessary DC power for operation of the detector.
 2. Supervise the detector circuit and all relay coils.
 3. Provide power to the neon alarm indicators.
 4. Provide one set of normally open and one set of single pole, double throw alarm operated relay contacts (5A, 120V, AC).
 5. Provide one set of single pole, double throw operated relay contacts (5A, 120V, AC).
- C. The unit shall be bolted directly to the duct or plenum wall. A template shall be provided for making necessary cutouts and holes. Complete instructions shall be provided with units.
- D. Unit shall be capable of stable operation from 0 deg. to 150 deg. F.
- E. Sampling tubes shall be EMT tubing, 1/2-inch diameter, length and supports as required to extend across plenum or duct (longest dimension). Quantity and location of sampling tubes shall be as required for representative sampling.
- F. Quantity and location of smoke detectors shall be as recommended by manufacturer to comply with NFPA 90A, but in no case less than indicated on the drawings.
- G. Smoke detectors located in HVAC systems and shown on the Mechanical Floor Plans shall be furnished, installed, tested and adjusted under this section of the specifications, unless indicated otherwise. 115 volt wiring shall be provided under Division 26 of this specification.

2.17 FANS

- A. All fans shall be U.L. listed and AMCA certified.
- B. Submit fans clearly outside of unstable air range with adjustment available to increase or decrease rpm.
- C. Propeller Fans: Belt driven, axial type sidewall propeller fans, statically and dynamically balanced and constructed with fabricated steel, fabricated aluminum, or cast aluminum blades. Polished steel shafts shall be mounted in permanently lubricated ball bearing pillow blocks. Drive frame panel and collar assemblies shall be painted steel with bolted or welded construction. Include inlet and outlet guards conforming to OSHA requirements and wall mounting collar. Model numbers are Greenheck; approved equals shall include Penn, Peerless, Acme Mfg. or Cook.

2.18 ELECTRIC WALL HEATER

- A. Heaters shall be UL Listed with capacities, voltages and control options as specified in schedule. Units shall be commercial quality with 18 gauge steel front cover. Cabinet to be finished with epoxy/polyester powder coated neutral beige finish.
- B. Provide durable tubular heating elements with fins.
- C. Provide 160 CFM blower with closed, factory lubricated motor. Fan delay shall be used to purge heater of residual heat.
- D. Terminals accept one power source for connection to 208V with integral thermostat. Suitable for copper wire, sized at 125% of rated load per NEC.
- E. Built-in thermostat included with control knob or tamper proof. Optional 24 V relay with transformer is available for remote thermostat.
- F. Acceptable manufacturers include: Reznor, Brasch and Markel.

2.19 RELIEF-INTAKE-EXHAUST HOODS

- A. Relief Hood Description: Heavy gauge aluminum construction with hood constructed from formed, arched panels with interlocking seams, birdscreen, backdraft damper and roof mounting curb. Unit shall be capable of relieving the specified cfm at a maximum static pressure drop as scheduled on the plans. Greenheck "FABRAHOOD", Acme, Carnes, Cook, Western Vents & Curbs, or equal.

2.20 PACKAGED ROOFTOP 100% OUTSIDE AIR GAS-FIRED UNIT HEATER

- A. General:
 - 1. The high efficiency, S-Series HTHV Direct Gas-Fired Heater shall be manufactured, assembled and factory tested to assure proper alignment of assemblies and performance of controls and other components. Each heater must be design certified by CSA International to be in compliance with ANSI Standard Z83.4 · CSA 3.7 for Non-Recirculating Direct Gas-Fired Industrial Air Heaters and be labeled ASHRAE 90.1 compliant. Each heater shall be capable of achieving 160°F at 0° outdoor temperature in accordance with the terms of the certification. The standard heater mounting package, including all specified components, shall be roof top.
- B. Construction:
 - 1. Each Blow-Thru space heater shall be constructed with the burner section located at the blower discharge, isolating the blower, motor, drive and control components from operationally detrimental high temperatures. The construction of each heater shall be built around a structurally reinforced, unitized housing and base made of G90 galvanized steel and shall be painted with a gray polyester powder paint finish. Outdoor mounted heaters

shall have watertight access panels to the blower, motor and drive, and gas train. The control enclosure shall be directly accessible from the exterior of the heater and shall be watertight with a full length, continuous stainless steel hinge and full perimeter gasket seal.

C. Blower:

1. The blower shall be constructed with a discharge transition duct which is approximately 2 1/2 wheel diameters shall be a double width inlet (DWDI), forward-curved centrifugal fan with a painted housing. The fan wheel shall be statically and dynamically balanced. The fan bearings on Series S1200 (with 5 HP motors), S1600, S1850 heaters shall have self-aligning, sealed ball bearings with grease fittings. Fan bearings are to be located out of the heated air stream. Fan speed shall be at least 25% below the first critical speed for the shaft. The shaft shall be coated with a rust inhibitor. Bearings slingers shall be provided to minimize airborne moisture access to the fan bearings.

D. Motor/Drive:

1. The motor shall be a 5/7.5 HP, ball bearing type, open drip-proof construction, designed for continuous duty at 460 volt 3 phase 60 Hz, and shall have a 1.15 service factor. The motor bearings shall be located out of the heated air stream. The motor mount is to be on an adjustable sliding base. The fan drive shall be a heavy duty V-belt drive designed for a 1.5 minimum service factor based on motor horsepower.

E. Burner:

1. The direct gas-fired burner shall be suitable for natural gas. The burner shall have stainless steel burner plates with non-clogging orifices. The burner shall produce less than 5 PPM (parts per million) carbon monoxide and 0.5 PPM nitrogen dioxide over its entire firing range. The burner shall be warranted for five years. The burner shall be furnished with a low voltage/hot surface ignition system and stainless steel flame rod.

F. Gas Controls:

1. The temperature control system shall be EDL (Electronic Discharge Local) for all heaters. The EDL temperature control utilizes the Maxitrol Series 14 modulation controls. A gas valve leak test switch shall be provided to permit field verification of the gas tightness of the valve seats for heaters over 400,000 BTU/hr. A high gas pressure switch is required in applications where the gas supply pressure to the heater exceeds 14" WC.

G. Controls:

1. The heater shall be furnished with factory mounted controls to include low temperature cutout, entering air thermostat, pre-purge timer, patented low fire start control, service switches for blower and burner operation at the heater, non-fused disconnect switch, IEC motor starter with single phase overload protection, redundant gas valves, pressure regulator, electronic temperature controls, and a low voltage, class 2 transformer for remote.

H. Manufacturer:

1. Cambridge or approval equal.

PART 3 - EXECUTION

3.1 INSTALLATION OF SHEET METAL WORK

- A. General: All necessary allowance and provisions shall be made in the installation of sheet metal ducts for the structural conditions of the building, and ducts shall be transformed or divided as may be required at no change in contract price. Whenever this is necessary, the required area shall be maintained. All of these changes, however, must be accepted and installed as directed at project. During the installation the open ends of ducts shall be protected to prevent debris and dirt from entering.
- B. Whenever exposed ducts pass through walls, floors, or ceilings, a flanged sheet metal collar fitting close around ducts shall be slipped along duct until flange is tight against finished surface covering edges of openings and presenting a neat appearance. Collar shall be locked to duct.
- C. Ductwork is frequently routed through bar joists and between bar joists. Contractor shall coordinate duct locations with joist submittals prior to fabrication.
- D. Contractor shall submit fabrication drawings of not less than 1/4" scale for approval prior to fabrication.

3.2 CLEANING

- A. All ducts, coils, housing, registers, grilles, fans, etc., shall be clean when installed and shall be kept clean until the system is completed. As the various parts of the system are installed, they shall be wiped or blown clean and openings taped dust-tight with heavy paper or cardboard until the system is completed and ready for testing. At that time all covers and protective wrappings shall be removed. Where one has been torn or previously removed, the duct, coil, register, etc., shall be carefully cleaned of any dirt or dust that has entered the opening. Open ends of all ductwork shall be closed off with plastic during construction to minimize dust and litter accumulation.

3.3 DUCT PENETRATIONS

- A. Where ducts are shown connecting to masonry openings and along edges of all plenums at floors and walls, provide a continuous 2" x 2" x 1/8" galvanized angle iron which shall be bolted to the construction and made airtight to the same by applying caulking compound. Sheet metal in these locations shall be bolted to the angle iron. Seal fire and/or smoke wall and all floor penetrations with Dow Corning, or equivalent, 3-6548 Silicone RTV foam.

3.4 FLEXIBLE CONNECTIONS

- A. Provide flexible connections, not less than 4" wide, constructed of heavy waterproof woven plastic coated glass fabric at locations indicated on the drawings and at the inlet and outlet connection at each fan unit where directly connected to duct system. Flexible connections shall be securely fastened to the equipment and to the ductwork by a galvanized iron band, provided with tightening screws. Fabric for flexible connections used in special exhaust systems shall be compatible for service. Provide steel spring vibration isolators spanning across flexible connections of isolated fan housings to prevent blow-apart horizontal displacement of fan housings. Flexible connections exposed to the ultra violet rays of the sun shall be equivalent to Ventlon as manufactured by Ventfabrics, Inc.

3.5 HAND AND SPLITTER DAMPERS

- A. Install hand operated volume and splitter dampers at locations and of sizes shown and/or as required for proper balancing. Volume dampers shall be controlled by heavy duty locking quadrants mounted on the outside of the duct. Where ducts are insulated, the damper rod shall be extended and the operator shall be mounted on the outside of the insulation. Splitter dampers shall be at least 1-1/2 times as long as the narrowest adjacent split. All damper fittings must be heavy commercial items and must be accepted by the Architect before installation.
- B. Splitter dampers above fixed finished ceilings shall be operated by Young Regulators No. 912 or 914 controllers with adjustment accessible at the face of finished ceiling.
- C. Supporting dampers: Dampers shall be supported by properly reinforcing the ductwork or sheet metal walls at the damper locations to carry the weight of the dampers and the force exerted on the dampers due to air pressure, or shall be supported independent of ductwork from the ceiling or floor, as conditions at the site determine. Damper frames shall be bolted - not welded - to prevent frame distortion.

3.6 CROSS BREAKING

- A. Low velocity rectangular sheet metal ducts shall be cross broken on the four sides of each 4-foot panel. All vertical and horizontal sheet metal barriers, duct offsets, elbows, as well as 4-foot panels of straight sections of ducts shall be cross broken. Cross breaking shall be applied to the sheet metal between the standing seams or reinforcing angles; the center of cross break shall be of the required height to assure surfaces being rigid.

3.7 TEST HOLES IN DUCTWORK

- A. Furnish test holes in ducts at locations required by the Testing and Balancing Team for testing of air quantities in ducts. Ventlok No. 699 or accepted equivalent closures shall be provided and installed for each test hole, with sufficient neck length to penetrate the insulation.

3.8 HANGERS AND SUPPORTS

- A. It is essential that all ducts shall be rigidly supported. Hangers shall be per the 2012 IMC and SMACNA Standards. Where vertical ducts pass through floors or roofs, heavy supporting angles shall be attached to ducts, and to structure. Angles shall be of sufficient size to support the ductwork rigidly and shall be placed on at least two sides of the duct.
- B. Construct hangers for rectangular ductwork from galvanized iron per the 2012 IMC and SMACNA standards. Hangers shall extend down the sides of rectangular ducts the full depth of the duct and shall be bent underneath the duct 2". Hangers shall be secured to the duct using sheet metal screws or rivets of appropriate sizes on 6-inch centers, but not less than two screws in the side and one on the bottom of each hanger.

3.9 GRILLES, DIFFUSERS, AND REGISTERS

- A. Paint ductwork visible behind grilles and registers flat black. No sheet metal to be visible through air inlets and outlets.

3.10 V-BELT FAN DRIVES

- A. Furnish and install new sheaves, pulleys and belts, and readjust drives, if necessary, to obtain the scheduled air flows of adjustable drive fans.

3.11 TESTING FOR DUCT LEAKAGE:

- A. A test of a representative sample of the supply duct for each air system is required. If sample is defective, the contractor shall repair or modify the construction. If results of sample test pass, Contractor will be permitted to proceed without further testing.
- B. Contractor shall, at the beginning of the work construct, erect and leak test a representative sample of the duct construction to be used at the appropriate pressure class. The sample specimen shall include at least five transverse joints, typical seams, and access door and at least two typical branch connections plus an elbow.
- C. The leakage amount shall not exceed the allotted amount for the pressure class or the allotted amount for that portion of the system, whichever is applicable.

DUCT CONSTRUCTION CLASS	LEAKAGE CLASS
10" W.G.	3
6" W.G.	6
4" W.G.	6
3" W.G.	12

NOTE: See Section 4 of the SMACNA leakage test manual for normal classification.

- D. Leakage test procedures shall follow the outlines and classifications in the SMACNA HVAC Duct Leakage Test manual.
- E. If specimen fails to meet allotted leakage level, the contractor shall modify to bring it into compliance and shall retest it until acceptable leakage is demonstrated.
- F. Tests and necessary repair shall be completed prior to concealment of ducts.

3.12 TESTING

- A. The complete air tempering system will be tested and balanced as specified in Section 23 05 93. If any equipment fails to produce the specified conditions due to installation, performance, or workmanship, the Contractor shall make any necessary changes to satisfy the specified conditions.
- B. Before the ceiling is installed and final connections are made it will be required that the fans be operated at full capacity to blow out dirt and debris from the ducts. If it is not practical to use the main supply blower the ducts may be blown out in sections by a portable fan. After the ducts have been cleaned and air tightness test shall be made on all ductwork. A pressure 50% greater than the operating pressure with a minimum of 2" water column will be required. All leaks shall be sealed with high pressure sealant. DUCT TAPE OR FOIL TAPE WILL NOT BE PERMITTED. Prior to sealing the ductwork, the contractor shall provide to the Architect/Engineer for approval all the information on the sealer that the contractor intends to use on the ductwork.
- C. The Testing and Balancing Agency shall verify in writing that all tests were satisfactorily completed and shall submit the certification to the Architect.

3.13 REFRIGERANT LINES AND CONDENSATE DRAIN LINES

- A. Provide refrigerant piping from air handling unit to condensing unit in accordance with manufacturer's recommendations, using hard drawn copper tubing. Size piping per manufacturer's instructions.
- B. Provide condensate drain pipes from fan coil units and air handling unit drain pans to designated location shown on drawings. Provide minimum 1/8 inch per foot slope on all horizontal pipes and provide clean-outs in all changes in direction.

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SECTION 260001

ELECTRICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Architectural, Structural, Mechanical and other applicable documents also apply to work of this section.

1.2 DESCRIPTION OF WORK:

- A. The contract documents indicate the extent of electrical work. Provide all labor, materials, equipment, supervision and service necessary for a complete electrical system as described in divisions 26, 27, and 28.

1.3 RELATED SECTIONS:

- A. Other Divisions relating to electrical work apply to the work of this section. See other applicable Divisions including, but not necessarily limited to:
 - 1. Division 1 – General and Supplementary Conditions
 - 2. Division 2 – Existing Conditions
 - 3. Division 3 – Concrete
 - 4. Division 5 – Metals
 - 5. Division 6 – Wood, Plastics, and Composites
 - 6. Division 7 – Thermal and Moisture Protection
 - 7. Division 8 – Openings
 - 8. Division 9 – Finishes
 - 9. Division 21 – Fire Suppression
 - 10. Division 22 – Plumbing
 - 11. Division 23 – Heating Ventilating and Air Conditioning
 - 12. Division 27 – Communications
 - 13. Division 28 – Electronic Safety and Security

1.4 INTERPRETATIONS OF DRAWINGS AND SPECIFICATIONS:

- A. Prior to bidding the job, submit requests for clarification in writing to the Architect/Engineer prior to issuance of the final addendum.
- B. After signing the contract, provide all materials, labor, and equipment to meet the intent, purpose, and function of the contract documents.
- C. The following terms used in Division 26, 27, and 28 documents are defined as follows:

1. "Provide" - Means furnish, install, and connect, unless otherwise indicated.
2. "Furnish" - Means purchase new and deliver in operating order to project site.
3. "Install" - Means to physically install the items in-place.
4. "Connect" - Means make final electrical connections for a complete operating piece of equipment. This includes providing conduit, wire, terminations, etc. as applicable.
5. "Or Equivalent" - Means to provide equivalent equipment. Such equipment must be approved by the Engineer prior to bidding.

1.5 EXAMINATION OF SITE:

- A. Visit the site and verify existing field conditions prior to submitting bid.
- B. All costs arising from site conditions and/or preparation shall be included in the base bid. No additional charges will be allowed due to inadequate site inspection.

1.6 QUALITY ASSURANCE:

- A. Perform work in accordance with all governing codes, rules, and regulations including the following minimum codes (latest editions or as otherwise accepted by the Authorities Having Jurisdiction):
 1. National Electric Code (NEC)
 2. International Building Code (IBC)
 3. International Fire Code (IFC)
 4. International Mechanical Code (IMC)
 5. International Plumbing Code (IPC)
 6. International Energy Conservation Code (IECC)
 7. International Fire Code (IFC)
 8. American Disability Act (ADA)
 9. National Electrical Safety Code (NESC)
 10. Local Codes and Ordinances
- B. Comply with all standards where applicable for equipment and materials including the following minimum standards:
 1. Underwriter's Laboratories (UL)
 2. American Society for testing Materials (ASTM)
 3. Certified Ballast Manufacturers (CBM)
 4. Insulated Cable Engineers Association (ICEA)
 5. National Electrical Manufacturer's Institute (NEMA)
 6. American National Standards Institute (ANSI)
 7. Electrical Testing Laboratories (ETL)
 8. National Fire Protection Association (NFPA)
 9. Institute of Electrical and Electronics Engineers (IEEE)
 10. American Institute of Electrical Engineer's Electrical Power
 11. Systems and Grounding in Commercial Construction
 12. Illuminating Engineers Society (IES)
- C. Provide new electrical equipment conforming to all requirements as set forth in the above standards. Provide UL labeled equipment where such label is applicable.
- D. Comply with all state and local codes and ordinances. When conflicts occur among codes, standards, drawings, and/or specifications, the most stringent requirements shall govern.

- E. Obtain all permits, inspections, etc. required by authority having jurisdiction. Include all fees in bid. Provide a certificate of approval to the owner's representative from the inspection authority at completion of the work.
- F. Provide only first-class workmanship from competent workers, conforming to the best electrical construction practices.
- G. The contractor shall have a current state contracting license applicable to type of work to be performed under this contract.

1.7 SUBMITTALS:

- A. Review of Submittals shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from the Contract Document's requirements. The noting of some errors but overlooking others, during the submittal review process, does not grant the Contractor permission to proceed in error. Regardless of any information contained in the shop drawings and cut sheets, the requirements of the Contract Document's shall govern and are not waived or superseded in any way by the review of the shop drawings and cut sheets.
- B. Submit only materials and equipment specified in Construction Documents or Addendums.
- C. Submittals are reviewed, not approved. Comments made within submittals do not alter the contract documents in any way. The contractor is still responsible, regardless of comments (if any) made within Submittals, for complying with drawings and specifications.
- D. Notify Engineer in writing if any of the submittal review comments alter the Construction Documents or affect the Contract cost. A submittal review comment which alters the Construction Documents and/or increases/decreases cost of a product is not an authorization to the Contractor under any circumstances to proceed. It is the responsibility of the Contractor to ensure compliance.
- E. Electronic Submittal Requirements:
 1. Provide submittals in Portable Document Format (PDF).
 2. Documents must be electronically bookmarked by Division (i.e. 26, 27 and 28), Specification section (i.e. 260120), and individually for each item submitted for light fixtures, switchgear, transformer, panelboard etc. and keyword searchable using Adobe Acrobat (<http://www.adobe.com/acrobat>) or Bluebeam Revu (<http://www.bluebeam.com>) for each relevant section.
 3. Electronically highlight all options for light fixtures, electrical equipment, etc. Manual highlighting and scanning of the documents are not acceptable and will not be reviewed.
 4. Do not submit catalog sheets which describe several different items in addition to those items to be used unless all relevant information is clearly identified.
 5. Provide combined submittals grouping the related specification sections together.
 6. A maximum of one submittal per specification section is allowed. It is not acceptable to provide a product-by-product submittal. Single product by product submittals will not be reviewed.
 7. If a submittal or a portion of a submittal is rejected or marked as incomplete, provide only outstanding or missing submittal items. Resubmittal of the previously reviewed and approved items is not required and will not be reviewed if submitted for the second time.
 8. Provide only specified products or products approved by addendum. Substitutions shall not be included in the submittal.
 9. Questions or clarifications shall not be included in the submittal. Submit Request for

Information for any outstanding questions or clarification about the submitted products.

F. Scheduling:

1. A minimum period of two weeks (business days only), exclusive of transmittal time, will be required each time Submittals are submitted or resubmitted for review. This time shall be considered by the Contractor when scheduling submittal data.

G. Response to Specifications:

1. A point-by-point statement of compliance with the specifications must be submitted with each individual submittal.
2. The statement of compliance shall consist of numbered specification paragraphs and shall be located at the front of the submittal. Each specification paragraph shall be cross referenced to the page/drawing in the submittal on which the compliance is confirmed. The confirming data on the page/drawing shall be highlighted for ready identification.
3. Where the proposed system complies fully, indicate by placing the word "comply" next to the subparagraph.
4. Where the proposed system does not comply or accomplishes the stated function in a manner different from that described, provide a full description of the deviation.
5. Each sheet of the submittal shall be sequentially numbered in the form of "Sheet x of y" where "x" is the sequential number of the sheet and "y" is the total number of the sheets in the submittal.
6. A submittal which does not include a point-by-point statement of compliance as specified shall be rejected.

1.8 OPERATION AND MAINTENANCE MANUALS:

- A. Provide operating instruction and maintenance data manuals for materials and equipment as required by each section of the specifications.
- B. Submit an electronic copy of Operations and Maintenance Manuals in Portable Document Format (PDF) at least four weeks before substantial completion of the project.
 - 1.
- C. Include complete cleaning and servicing data compiled in clearly and easily understandable form. Show serial numbers of each piece of equipment, complete lists of replacement parts, motor ratings, etc. Each unit shall have its own individual sheet.

1.9 RECORD DRAWINGS:

- A. Maintain on a daily basis a complete set of "Red-Lined Drawings", reflecting an accurate record of all work including addendums, revisions, and changes. Indicate precise dimensioned locations of all concealed work and equipment, including concealed or embedded conduit, junction boxes, etc. Record all "Red-Lined Drawing" information on a set of full sized prints of the contract drawings.
- B. Certify the "Red Lined Drawings" for correctness. Indicate on each drawing the name of the general and electrical contractors with signatures of each representative responsible for the work.
- C. The electrical engineering design firm will create record (as-built) drawings from the certified

red-lined drawings; however, the general and electrical contractors retain the responsibility for the accuracy of the record drawings.

1.10 WARRANTY:

- A. Ensure that the electrical system installed under this contract is in proper working order and in compliance with drawings, specifications, and/or authorized changes and is free from electrical defects. Without additional charge, replace or repair, to satisfaction of the owner's representative, except from ordinary wear and tear, any part of the installation which may fail or be determined unacceptable within a period of one (1) year after final acceptance or as otherwise indicated in individual sections, but in no case less than one year. Warranty incandescent and fluorescent lamps only for a period of two months from the date of substantial completion.
- B. Provide complete warranty information for each item including beginning of warranty period, duration of warranty, names, addresses, and telephone numbers and procedures for filling a claim and obtaining warranty services. Written warranties and guarantees are to be submitted separately as:
 - 1. Originals bound in a binder clearly identified with the title, "WARRANTIES AND GUARANTEES," the project name, the project number, and the Contractor's business name.
 - 2. Electronic documents in *.pdf format.

PART 2 - PRODUCTS

2.1 GENERAL:

- A. All materials shall be new and shall bear the manufacturer's name, trade name, and the approved testing laboratory such as the UL label in every case where a standard has been established for that particular material. Used materials are acceptable only if specifically indicated on drawings.

2.2 SUBSTITUTION OF MATERIALS:

- A. Provide only specified products or products approved by addendum. Substitutions will be considered if two copies of the proposal is received at the architect's/engineer's office eight (8) working days prior to the bid day. Include in the proposal the specified and proposed catalog numbers of the equipment under consideration and a catalog cut sheet(s) with pictorial and descriptive information. Certify that the equipment proposed is equal to that specified, that it has the same electrical and physical characteristics, compatible dimensions, and meets the functional intent of the contract documents.
- B. It is the responsibility of the contractor to make all substituted equipment comply with the intent of the contract documents and bear all cost associated with conflicts arising from the use of substituted equipment.
- C. Provide samples if so required by the architect or engineer before or after bid day.

2.3 SPARE PARTS:

- A. Provide spare parts (fuses, diffusers, etc.) as specified in each section of the specifications.
- B. Stock of all spare items shall be delivered as directed to Owner prior to substantial completion.
- C. All components shall be labeled to match construction document nomenclature.

PART 3 - EXECUTION

3.1 GENERAL:

- A. Workmanship: Provide only first class workmanship from competent workers. Defective materials or workmanship will not be allowed on the project. Provide competent supervision for the work to be accomplished. Keep same foreman on the job, unless a change is authorized by the engineer.
- B. Coordination: Prior to construction, layout electrical work and coordinate work with other trades. Sequence, coordinate, and integrate installation of materials and equipment for efficient flow of the work. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed. Install electrical equipment to facilitate maintenance and repair or replacement of equipment components. Coordinate the installation of electrical materials and equipment above ceilings with suspension system, mechanical equipment and systems, and structural components. Coordinate with all utilities including power, communication, and data installations.
- C. Provide cutting, drilling, channeling, etc. only as necessary for proper completion of the work. Do not cut structural members unless authorization is issued in writing by the architect/engineer.
- D. Repairs: Repair damage to building, grounds, or utilities as a result of work under this contract at no additional cost to the owner.
- E. Dimensioning: Electrical drawings indicate locations for electrical equipment only in their approximate location, unless specifically dimensioned. Do not scale electrical drawings for dimensional information. Refer to architectural drawings and shop drawings where applicable for locations of all electrical equipment. Field verify all dimension on the job site.
- F. Provide block-outs, sleeves, demolition work, etc., required for installation of work specified in this division.
- G. Standards: Provide electrical installation in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.
- H. All workmen doing work of any nature on State of Utah projects must at all times carry their electrician's license with them and show it upon request. The acceptable ratio of apprentice to journeyman electricians on the job is 1:1.

3.2 REQUESTS FOR INFORMATION:

- A. When it is clearly apparent that information is not adequately described in the construction

documents or when a coordination problem exists, submit a request for information (RFI) through proper contractual channels. The electrical engineering design firm will provide a response through its contractual channel. Although verbal direction may be given to expedite changes, responses are not considered part of the contract documents until a change order has been issued and signed by the Owner or his designated representative. The Contractor shall bear all costs associated with proceeding on any change order that has not been approved by the Owner or his designated representative.

- B. Any damages caused by construction delays due to frivolous RFI's, will be born solely by the Contractor.

3.3 SAFETY PRECAUTIONS:

- A. Provide all necessary guards or construction barriers and take all necessary precautions to insure the safety of life and property.

3.4 CLEAN:

- A. Clean up all equipment, conduit, fittings, wire, packing cartons, plastic, and other debris that is a direct result of the installation of the work of this division, both during the execution, and at the conclusion, of the project. Keep the site clean and safe during the progress of the work. Clean fixtures, interior and exterior of all equipment, and raceways prior to final acceptance. Vacuum interior of all electrical panels and equipment. Correct any damaged equipment. Touch-up or repaint if necessary.

3.5 TEMPORARY POWER:

- A. Make arrangements with the proper institution authority for all temporary electricity.
- B. Provide temporary power, complete with metering and wiring for lighting and power outlets for construction tools and equipment. Report the initial meter reading to the owner/institution, or otherwise as may be directed.
- C. Service shall be provided with a main disconnect and all 20 ampere receptacles protected by 20 amp GFI, single-pole breakers. No attempt is made herein to specify construction power requirements for equipment in detail. Provide all electrical equipment and wiring as required.
- D. As soon as permanent power and metering is available, the temporary power supply shall be disconnected and removed from the project site.
- E. All temporary wiring shall meet the requirements of NEC Article 590 and the State Industrial Commission.

3.6 STORAGE AND PROTECTION OF MATERIALS:

- A. Provide storage space for storage of materials and apparatus and assume complete responsibility for all losses due to any cause whatsoever. Lost or damaged materials will be replaced at no additional cost to owner. Do not store materials and apparatus in any public thoroughfare or in any area on the site where such storage would constitute a hazard to persons in the vicinity. Protect completed work, work underway, and apparatus against loss or damage.

3.7 EXCAVATING FOR ELECTRICAL WORK:

- A. Verification: Prior to excavating, locate and protect existing utilities and other underground work in a manner which will ensure that no damage or service interruption will result from excavating and backfilling. Observe all State and Local codes prior to excavating. Do not disturb walls, footings, and other structural members in any way.
- B. Protection: Provide barricades, warning signs, and illumination to protect persons from injury at excavations. Provide temporary coverings and heat as necessary to protect bottoms of excavations from freezing and frost action. Do not install electrical work on frozen excavation bases or subbases.
- C. Coordination: Do not excavate for electrical work until the work is ready to proceed without delay.
- D. Excavated Materials: Temporarily store excavated materials near excavation in manner which will not interfere with or damage excavation or other work. Dispose of and remove excavated materials which are either in excess of quantity needed for backfilling or do not comply with the requirements for backfill material.
- E. Burial Depths: Burial depths must comply with NEC Section 300-5 (or State of Utah requirements, whichever is more stringent), unless noted otherwise on drawings.
- F. Excavation Permits: Obtain all shut-down and excavation permits as may be required for proper completion of the work.

3.8 BACKFILL MATERIALS:

- A. For buried conduits or cables (other than below slab-on-grade, or concrete-encased), provide 2" thickness of well-graded sand on all sides of conduits or cables.
- B. For trench backfill to within 6" of final grade, provide soil material suitable for compacting to required densities.
- C. For top 6" of excavation, provide top soil.
- D. Backfill excavations in 8" high courses of backfill material, uniformly compacted to the following densities (percent of maximum density, ASTM D 1557), using power-driven hand-operated compaction equipment:
 - 1. Lawn/Landscaped Areas: 85 percent for cohesive soils, 95 percent for cohesionless soils.
 - 2. Paved Areas, other than roadways: 90 percent for cohesive soils, 95 percent for cohesionless soils.
- E. Where subsidence is observable at electrical work excavations during project warranty period, remove surface, add backfill material, compact, and replace surface treatment. Restore surface to original condition.

3.9 ROOF PENETRATIONS:

- A. Where raceways and/or cables penetrate roofing, provide 26 gauge galvanized iron roof jack, sized to fit tightly to raceway and/or cable for weather-tight seal, and with flange extending a

minimum of 9" under roofing on all sides. Seal opening between raceway and roof jack with approved sealant. Coordinate all work with division 7.

3.10 FIRE PENETRATION SEALS:

- A. Seal all raceway and/or cable penetrations through fire-rated floors, wall, and ceilings to prevent the spread of smoke, fire, toxic gas or water through the penetration either before, during or after fire. Provide penetration sealants and fittings of ratings to match the rating of the penetrated materials so that the original fire rating of the floor or wall is maintained as required by Article 300-21 of the NEC.
- B. Sealant Systems: Provide sealants, wall wraps, partitions, caps, and other accessories complying with UL 1479 (ASTM E-814) from the following where applicable:
 - 1. 3M Fire Barrier Sealing Penetration System
 - 2. Chase Foam Fire Stop System
 - 3. Thomas and Betts Flame Safe Fire Stop System
 - 4. Nelson Fire Stop Products
- C. Fittings: Where applicable, provide OZ Type CFSF/I and CAFSF/I fire seal fittings for conduit and cable penetrations through concrete and masonry wall, floor, slabs, and similar structures.
- D. Install sealants and fittings in accordance with all manufacturer's written instructions.

3.11 LABELING:

- A. Engraved black plastic laminated, with white-core labels, 1/16" thick, shall be permanently attached on both the interior and exterior the following electrical equipment:
 - 1. Branch panels
 - 2. Switchgear
 - 3. Disconnect switches
 - 4. Motor starter and controls junction boxes (power and auxiliary)
 - 5. Push buttons
 - 6. Thermal switches
 - 7. Time switches
 - 8. Motor control centers
 - 9. Transformer
 - 10. Similar equipment.
 - 11. Lighting contactors and associated switches
 - 12. Junction boxes larger than 4x4x1/2.
- B. The labels shall have 1/4" high, engraved letters, such as EF-1, AC-1, Panel A, etc.

3.12 CONCRETE BASES:

- A. Housekeeping Pads: Unless otherwise noted, provide 4" high reinforced concrete bases for all floor-mounted or floor-standing electrical equipment, including but not necessarily limited to the following:
 - 1. Transformers
 - 2. Switchboards

- 3. Distribution panels
- 4. Similar Equipment

- B. Extend bases 4" beyond equipment or mounting rails on all sides or as shown on the drawings. Notwithstanding this requirement, coordinate with equipment manufacturer, shop drawings, and height of base to ensure compliance with NEC 380-82.
- C. Concrete bases: Refer to Section 265613 – LIGHTING POLES AND STANDARDS.
- D. Transformer Pads: Provide and locate properly sized concrete pad-vaults for power company furnished pad mounted transformers in accordance with power company clearance requirements.

3.13 TESTS:

- A. Notify engineer prior to all testing specified herein at least three business days prior to testing. Engineer shall observe all tests to insure the proper operation of the electrical system.

3.14 PROJECT FINALIZATION AND START-UP:

- A. Upon completion of the work, have each factory representative and/or subcontractor assist in start-up and testing of their respective systems.
- B. Have each representative give personal instructions on operating and maintenance of their equipment to the owner's maintenance and/or operation personnel.
- C. Have representatives certify each system with a written statement indicating that they have performed start-up and final check out of their respective systems.

3.15 FINAL REVIEW:

- A. Have the project foreman accompany their reviewing parties and remove coverplates, panel covers, access panels, etc. as requested, to allow review of the entire electrical system.

3.16 TRAININGS:

- A. Provide and implement a complete and comprehensive training program for Owner selected personnel as required by each section of the specifications.
- B. All trainings to be coordinated through the Owner's designated representative. As training sessions are completed, the trainer shall provide the Owner a document listing all the personnel who attended, received, and completed the training program.
- C. All trainings shall be video recorded and a copy of each training (in MP4, MOV, or other format as preferred by the Owner) shall be submitted to the Owner at the end of the training session.

END OF SECTION 260001

SECTION 260519

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper building wire.
2. Aluminum building wire.
3. Fire-alarm wire and cable.
4. Connectors and splices.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Copper building wire.
2. Aluminum building wire.
3. Fire-alarm wire and cable.
4. Connectors and splices.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

- 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. Alpha Wire; brand of Belden, Inc.
 2. Belden Inc.
 3. Cerro Wire LLC.
 4. Encore Wire Corporation.
 5. General Cable; Prysmian Group North America.
 6. Okonite Company (The).
 7. Service Wire Co.
 8. Southwire Company, LLC.
 9. WESCO.

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.

E. Conductor Insulation:

1. Type THHN/THWN-2. Comply with UL 83.

2.2 ALUMINUM BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn aluminum 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. Alpha Wire; brand of Belden, Inc.
2. Belden Inc.
3. Cerro Wire LLC.
4. Encore Wire Corporation.
5. General Cable; Prysmian Group North America.
6. Okonite Company (The).
7. Southwire Company, LLC.
8. WESCO.

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Aluminum, complying with ASTM B800 and ASTM B801.

E. Conductor Insulation:

1. Type THHN/THWN-2. Comply with UL 83.

2.3 FIRE-ALARM WIRE AND CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Allied Wire & Cable Inc.
2. CommScope, Inc.
3. Comtran Corporation.

4. Genesis Cable Products; Honeywell International, Inc.
 5. PYROTENAX; brand of nVent Electrical plc.
 6. Prysmian Cables and Systems; Prysmian Group North America.
 7. Radix Wire.
 8. Rockbestos-Suprenant Cable Corp.
 9. Superior Essex Inc.; subsidiary of LS Corp.
 10. West Penn Wire; brand of Belden, Inc.
- B. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.
- C. Signaling Line Circuits: Twisted, shielded pair, size as recommended by system manufacturer.
- D. Non-Power-Limited Circuits: Solid-copper conductors with 600 V rated, 75 deg C, color-coded insulation, and complying with requirements in UL 2196 for a two-hour rating.
1. Low-Voltage Circuits: No. 16 AWG, minimum, in pathway.
 2. Line-Voltage Circuits: No. 12 AWG, minimum, in pathway.

2.4 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors, splices, and lugs 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.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. 3M Electrical Products.
 2. ABB, Electrification Business.
 3. AFC Cable Systems; Atkore International.
 4. Gardner Bender.
 5. Hubbell Utility Solutions; Hubbell Incorporated.
 6. ILSCO.
 7. Ideal Industries, Inc.
 8. NSi Industries LLC.
 9. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
 10. Service Wire Co.
 11. TE Connectivity Ltd.
- C. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.
- D. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.
1. Material: Copper.
 2. Type: Two hole with standard barrels.
 3. Termination: Compression.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders:

1. Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
2. Copper for feeders smaller than No. 1 AWG; copper or aluminum for feeders No. 1 AWG and larger. Conductors must be solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits:

1. Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

C. Power-Limited Fire Alarm and Control: Solid for No. 12 AWG and smaller.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THHN/THWN-2, single conductors in raceway.

B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway .

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN/THWN-2, single conductors in raceway.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.

E. Feeders Installed below Raised Flooring: Type THHN/THWN-2, single conductors in raceway.

F. Exposed Branch Circuits, Including in Crawlspace: Type THHN/THWN-2, single conductors in raceway.

G. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.

H. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.

I. Branch Circuits Installed below Raised Flooring: Type THHN/THWN-2, single conductors in raceway.

J. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless steel, wire-mesh, strain relief device at terminations to suit application.

3.3 COLOR CODE

A. Color shall be factory applied or field applied for sizes larger than No. 8 AWG if authorities having jurisdiction permit.

B. Color shall be factory applied for secondary conductors between utility transformer and main service disconnect switch.

- C. Color-code 208/120-V system conductors:
1. Phase A: Black.
 2. Phase B: Red.
 3. Phase C: Blue.
 4. Neutral A: White with Black stripe.
 5. Neutral B: White with Red stripe.
 6. Neutral C: White with Blue stripe.
 7. Ground: Green.
 8. Isolated Ground: Green with Yellow tracer.

- D. Color-code 480/277-V system conductors:
1. Phase A: Brown.
 2. Phase B: Orange.
 3. Phase C: Yellow
 4. Neutral A: Gray with Brown stripe.
 5. Neutral B: Gray with Orange stripe.
 6. Neutral C: Gray with Yellow stripe.
 7. Ground: Green.

3.4 HOMERUN CIRCUITS

- A. Homerun circuits may be combined in common conduits at the option of the contractor in compliance with the following:
1. Three-Phase Installations: Not more than three single-phase circuits in one conduit, unless specifically noted otherwise, if each circuit is from a different phase.
 2. Single-Phase Installations: Not more than two single-phase circuits in one conduit, unless specifically noted otherwise, if each circuit is from a different phase.

3.5 VOLTAGE DROP

- A. Provide branch circuit conductors in sizes such that voltage drop for branch circuits do not exceed 3 percent at the farthest outlet. Provide service, feeder, and branch circuit conductors so that the voltage drop on the entire electrical system does not exceed 5 percent at the farthest outlet. This shall be strictly followed regardless of the conductor sizes indicated on the electrical drawings. Increase conductor sizes (and conduits where necessary to comply with NEC conduit fill requirements) as necessary to accommodate this requirement. Refer to Drawings for additional information.

3.6 INSTALLATION, GENERAL

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points in accordance with Section 260533.13 "Conduits for Electrical Systems" prior to pulling conductors and cables.
- C. 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.

- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."
- G. Provide a dedicated neutral for each line-to-neutral branch circuit. Size the neutral conductor the same as the phase conductor. In each outlet or junction box containing multiple neutral conductors, tag each neutral to identify which circuit it serves.

3.7 INSTALLATION OF FIRE-ALARM WIRE AND CABLE

- A. Comply with NFPA 72.
- B. Wiring Method: Install wiring in metal pathway according to Section 270528.29 "Hangers and Supports for Communications Systems."
 - 1. Fire-alarm circuits and equipment control wiring associated with fire-alarm system must be installed in a dedicated pathway system.
 - a. Cables and pathways used for fire-alarm circuits, and equipment control wiring associated with fire-alarm system, may not contain any other wire or cable.
 - 2. Signaling Line Circuits: Power-limited fire-alarm cables must not be installed in the same cable or pathway as signaling line circuits.
- C. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with fire-alarm system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
- D. Color-Coding: Color-code fire-alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire-alarm system junction boxes and covers red.
- E. Risers: Install at least two vertical cable risers to serve the fire-alarm system. Separate risers in close proximity to each other with a minimum one-hour-rated wall, so the loss of one riser does not prevent receipt or transmission of signals from other floors or zones.

3.8 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-486B.

- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
 - 1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inch of slack.
- D. Comply with requirements in Section 284621.11 "Addressable Fire-Alarm Systems" for connecting, terminating, and identifying wires and cables.

3.9 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.

3.10 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."

3.11 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Visual and Mechanical Inspection:
 - a. Inspect all service entrance, feeder, and branch circuit conductors for physical damage and proper connection.
 - b. Test cable mechanical connections to manufacturer's recommended values with a calibrated torque wrench.
 - c. Check cable color coding for compliance with electrical specifications.
 - 2. Electrical Tests:
 - a. Perform insulation resistance test on each conductors for feeders 100 amps and greater with respect to ground and adjacent conductors. Applied potential shall be 1000 volts dc for 1 minute. Minimum insulation resistance values shall not be less than two megaohms.
 - b. Perform continuity test to insure proper cable connection.
- B. Prepare test and inspection reports to record the following:
 - 1. Procedures used.
 - 2. Results that comply with requirements.

3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION 260519

SECTION 260526

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Grounding and bonding conductors.
2. Grounding and bonding clamps.
3. Grounding and bonding bushings.
4. Grounding and bonding connectors.
5. Grounding and bonding busbars.
6. Grounding (earthing) electrodes.

1.2 ACTION SUBMITTALS

A. Product Data:

1. For each type of product indicated.

B. Shop Drawings: including the following:

1. Test wells.
2. Rod electrodes.
3. Grounding arrangements and connections for separately derived systems.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data:

1. Include the following:
 - a. Plans showing locations of grounding features described in "Field Quality Control" Article, including the following:
 - 1) Test wells.
 - 2) Rod electrodes.
 - 3) Grounding arrangements and connections for separately derived systems.

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING CONDUCTORS

A. Equipment Grounding Conductor:

1. General Characteristics: 600 V, THHN/THWN-2 or XHHW-2, copper wire or cable, green color, in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. ASTM - Bare Copper Grounding and Bonding Conductor:

1. Referenced Standards: Complying with one or more of the following:
 - a. Soft or Annealed Copper Wire: ASTM B3
 - b. Concentric-Lay Stranded Copper Conductor: ASTM B8.
 - c. Tin-Coated Soft or Annealed Copper Wire: ASTM B33.
 - d. 19-Wire Combination Unilay-Stranded Copper Conductor: ASTM B787/B787M.

2.2 GROUNDING AND BONDING CLAMPS

- A. Description: Clamps suitable for attachment of grounding and bonding conductors to grounding electrodes, pipes, tubing, and rebar. Grounding and bonding clamps specified in this article are also suitable for use with communications applications; see Section 270526 "Grounding and Bonding for Communications Systems," for selection and installation guidelines.
- B. Source Limitations: Obtain products from single manufacturer.
- C. Performance Criteria:
 1. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2.3 GROUNDING AND BONDING BUSHINGS

- A. Description: Bonding bushings connect conduit fittings, tubing fittings, threaded metal conduit, and unthreaded metal conduit to metal boxes and equipment enclosures, and have one or more bonding screws intended to provide electrical continuity between bushing and enclosure. Grounding bushings have provision for connection of bonding or grounding conductor and may or may not also have bonding screws.
- B. Source Limitations: Obtain products from single manufacturer.
- C. Performance Criteria:
 1. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
 2. Listing Criteria:
 - a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.

2.4 GROUNDING AND BONDING CONNECTORS

- A. Source Limitations: Obtain products from single manufacturer.
- B. Performance Criteria:
 - 1. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
 - 2. Listing Criteria:
 - a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
 - b. Grounding and Bonding Equipment for Communications: UL CCN KDSH; including UL 467.

2.5 GROUNDING AND BONDING BUSBARS

- A. Description: Miscellaneous grounding and bonding device that serves as common connection for multiple grounding and bonding conductors.
- B. Source Limitations: Obtain products from single manufacturer.
- C. Performance Criteria:
 - 1. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
 - 2. Listing Criteria:
 - a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.

2.6 GROUNDING (EARTHING) ELECTRODES

- A. Description: Grounding electrodes include rod electrodes, ring electrodes, metal underground water pipes, metal building frames, concrete-encased electrodes, and pipe and plate electrodes.
- B. Source Limitations: Obtain products from single manufacturer.
- C. Performance Criteria:
 - 1. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. Listing Criteria:

- a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine facility's grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of electrical system.
- B. Inspect test results of grounding system measured at point of electrical service equipment connection.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with connection of electrical service equipment only after unsatisfactory conditions have been corrected.

3.2 SELECTION OF BUSBARS

- A. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Install bus horizontally, on insulated spacers 2 inch minimum from wall, 6 inch 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; connect to horizontal bus.

3.3 SELECTION OF GROUNDING AND BONDING CONDUCTORS

- A. Conductors: Install solid conductor for 8 AWG and smaller, and stranded conductors for 6 AWG and larger unless otherwise indicated.
- B. Custom-Length Insulated Equipment Bonding Jumpers: 6 AWG, 19-strand, Type THHN.
- C. Bonding Cable: 28 kcmil, 14 strands of 17 AWG conductor, 1/4 inch in diameter.
- D. Bonding Conductor: 4 AWG or 6 AWG, stranded conductor.
- E. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inch wide and 1/16 inch thick.
- F. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inch wide and 1/16 inch thick.

3.4 SELECTION OF CONNECTORS

- A. 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.

3.5 INSTALLATION

- A. Comply with manufacturer's published instructions.
- B. Reference Standards:
 - 1. Ground Bonding Common with 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.
 - 2. Consult Architect for resolution of conflicting requirements.
- C. Special Techniques:
 - 1. Conductors:
 - a. 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.
 - 2. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.
 - a. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
 - b. Make connections with clean, bare metal at points of contact.
 - c. Make aluminum-to-steel connections with stainless steel separators and mechanical clamps.
 - d. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
 - e. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
 - f. 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 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 disconnect-type connection is required, use bolted clamp.
 - g. 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 bolted clamp connector or bolt lug-type connector to pipe flange by using one of lug bolts of flange. Where 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 bolted connector.
3. Electrodes:
 - a. Ground Rods: Drive rods until tops are 2 inch 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 below-grade connections.
 - b. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least same distance from other grounding electrodes, and connect to service grounding electrode conductor.
 - c. Concrete-Encased Electrode (Ufer Ground):
 - 1) Fabricate in accordance with NFPA 70; use minimum of 20 ft of bare copper conductor not smaller than 4 AWG.
 - a) If concrete foundation is less than 20 ft long, coil excess conductor within base of foundation.
 - b) 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.
 - 2) Fabricate in accordance with NFPA 70; using electrically conductive coated steel reinforcing bars or rods, at least 20 ft long. If reinforcing is in multiple pieces, connect together by usual steel tie wires or exothermic welding to create required length.
4. Grounding at Service:
 - a. Equipment grounding conductors and grounding electrode conductors must be connected to ground bus. Install main bonding jumper between neutral and ground buses.
5. Grounding Separately Derived Systems:
 - a. Electrode must be connected to equipment grounding conductor and to frame of equipment.
6. Equipment Grounding:
 - a. Install insulated equipment grounding conductors with 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) Miscellaneous Equipment Circuits: Install insulated equipment grounding conductor in circuits supplying all other equipment.
- c. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.6 FIELD QUALITY CONTROL

A. 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 calibrated torque wrench in accordance with manufacturer's published instructions.
- 3. Test completed grounding system at each location where maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal[, at ground test wells][, and at individual ground rods]. Make tests at ground rods before conductors are connected.
 - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by 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 in accordance with IEEE Std 81.
 - c. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.
- 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 record of tests and observations. Include 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.

B. Nonconforming Work:

- 1. Grounding system will be considered defective if it does not pass tests and inspections.
- 2. Remove and replace defective components and retest.

3.7 PROTECTION

- A. After installation, protect grounding and bonding cables and equipment from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 260526

SECTION 260529

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Support, anchorage, and attachment components.
2. Fabricated metal equipment support assemblies.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
 - a. Slotted support systems, hardware, and accessories.
 - 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 licensed in Utah. For fabrication and installation details for electrical hangers and support systems.

1. Hangers. Include product data for components.
2. Slotted support systems.
3. Equipment supports.
4. 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. Delegated Design Submittals: For hangers and supports for electrical systems.

1. Include design calculations and details of hangers.
2. Include design calculations for seismic restraints.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified structural professional engineer to design hanger and support system.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32 inch diameter holes at a maximum of 8 inch on center in at least one surface.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. ABB, Electrification Business.
 - b. Allied Tube & Conduit; Atkore International.
 - c. CADDY; brand of nVent Electrical plc.
 - d. Cooper B-line; brand of Eaton, Electrical Sector.
 - e. Flex-Strut Inc.
 - f. G-Strut.
 - g. Gripple Inc.
 - h. Haydon Corporation.
 - i. MIRO Industries.
 - j. Metal Ties Innovation.
 - k. Rocket Rack; Robroy Industries.
 - l. Unistrut; Atkore International.
 - m. Wesanco, Inc.

- 2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
 - 3. Material for Channel, Fittings, and Accessories: Galvanized steel .
 - 4. Channel Width: Selected for applicable load criteria .
 - 5. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 6. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 - 7. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 - 8. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

- B. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

- C. 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 must have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body must be made of malleable iron.

- D. Structural Steel for Fabricated Supports and Restraints: ASTM A36/A36M steel plates, shapes, and bars; black and galvanized.

- E. 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; Illinois Tool Works, Inc.
 - 3) MKT Fastening, LLC.
 - 4) Simpson Strong-Tie Co., Inc.
2. Mechanical-Expansion Anchors: Insert-wedge-type, [zinc-coated] [stainless] steel, for use in hardened portland cement concrete, 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) Cooper B-line; brand of Eaton, Electrical Sector.
 - 2) Empire Industries, Inc.
 - 3) Hilti, Inc.
 - 4) ITW Ramset/Red Head; Illinois Tool Works, Inc.
 - 5) MKT Fastening, LLC.
3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F3125/F3125M, Grade A325.
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 SELECTION

- A. Comply with the following standards for selection and installation of hangers and supports, except where requirements on Drawings or in this Section are stricter:

1. NECA NEIS 101

- 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 specified in Section 260533.13 "Conduits for Electrical Systems."
- D. Comply with requirements for boxes specified in Section 260533.16 "Boxes and Covers for Electrical Systems."
- E. Provide seismic controls with hangers and supports in accordance with requirements specified in "Section 260548.16 "Seismic Controls for Electrical Systems."
- F. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and ERMC as required by NFPA 70. Minimum rod size must be 1/4 inch in diameter.
- G. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 - 1. Secure raceways and cables to these supports with single-bolt conduit clamps.

3.2 INSTALLATION OF SUPPORTS

- A. Comply with NECA NEIS 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 must be weight of supported components plus 200 lb.
- 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. To Light Steel: Sheet metal screws.
 - 6. 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 comply with seismic-restraint strength and anchorage requirements.
- D. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

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. Submit welding certificates.

3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated, but not less than 4 inch larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000 psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 033000 "Cast-in-Place Concrete."
- C. Anchor equipment to concrete base as follows:
 - 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:
 - 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 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.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

END OF SECTION 260529

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SECTION 260533.13

CONDUITS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Type EMT-S duct raceways and elbows.
2. Type HDPE duct raceways and fittings.
3. Type ERMCS duct raceways, elbows, couplings, and nipples.
4. Type FMC-S and Type FMC-A duct raceways.
5. Type LFMC duct raceways.
6. Type LFNC duct raceways.
7. Type PVC duct raceways and fittings.
8. Fittings for conduit, tubing, and cable.
9. Electrically conductive corrosion-resistant compounds for threaded conduit.

B. Products Installed, but Not Furnished, under This Section:

1. See Section 260553 "Identification for Electrical Systems" for electrical equipment labels.

C. Related Requirements:

1. Section 260519 "Low-Voltage for Electrical Power Conductors and Cables" for nonmetallic underground conduit with conductors (Type NUCC).

D. Rocky Mountain Power:

1. Fiberglass: Per Rocky Mountain Power requirements, UL 2515, fiberglass conduit and sweeps must be black with three red stripes to identify electric conductors inside.
2. This specification section is subject to other Rocky Mountain Power Requirements.

1.2 DEFINITIONS

- A. Conduit: A structure containing one or more duct raceways.
- B. Duct Raceway: A single enclosed raceway for conductors or cable.
- C. Duct Bank: An arrangement of conduit providing one or more continuous duct raceways between two points.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Type EMT-S duct raceways and elbows.
2. Type HDPE duct raceways and fittings.
3. Type ERM-C duct raceways, elbows, couplings, and nipples.
4. Type FMC-S and Type FMC-A duct raceways.
5. Type LFMC duct raceways.
6. Type LFNC duct raceways.
7. Type PVC duct raceways and fittings.
8. Fittings for conduit, tubing, and cable.
9. Electrically conductive corrosion-resistant compounds for threaded conduit.

PART 2 - PRODUCTS

2.1 TYPE EMT-S DUCT RACEWAYS AND ELBOWS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN FJMX; including UL 797.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.

C. UL FJMX - Steel Electrical Metal Tubing (EMT-S) and Elbows:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit; Atkore International.
 - b. Calconduit; Atkore International.
 - c. Emerson Electric Co.
 - d. Picoma; Zekelman Industries.
 - e. Republic Conduit; Nucor Corporation, Nucor Tubular Products.
 - f. Topaz Lighting & Electric.
 - g. Western Tube; Zekelman Industries.
 - h. Wheatland Tube; Zekelman Industries.
2. Material: Steel.
3. Options:
 - a. Minimum Trade Size: Metric designator 21 (trade size 3/4).
 - b. Colors: As indicated on Drawings or in other Division 26, Division 27, and Division 28 Specification Sections.

2.2 TYPE HDPE DUCT RACEWAYS AND FITTINGS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN EAZX; including UL 651A.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.

C. UL EAZX - Schedule 40 Electrical HDPE Underground Conduit (HDPE-40):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Blue Diamond Industries.
 - b. JM Eagle; J-M Manufacturing Co., Inc.
 - c. Petroflex North America.
 - d. Prysmian Cables and Systems; Prysmian Group North America.
 - e. Southwire Company, LLC.
2. Dimensional Specifications: Schedule 40.

2.3 TYPE ERM-C-S DUCT RACEWAYS, ELBOWS, COUPLINGS, AND NIPPLES

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN DYIX; including UL 6.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.

C. UL DYIX - Galvanized-Steel Electrical Rigid Metal Conduit (ERM-C-S-G), Elbows, Couplings, and Nipples:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit; Atkore International.
 - b. Calconduit; Atkore International.
 - c. Crouse-Hinds; brand of Eaton, Electrical Sector.
 - d. Killark; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - e. Patriot Aluminum Products, LLC.
 - f. Republic Conduit; Nucor Corporation, Nucor Tubular Products.
 - g. Topaz Lighting & Electric.
 - h. Western Tube; Zekelman Industries.
 - i. Wheatland Tube; Zekelman Industries.

2. Exterior Coating: Zinc.
3. Options:
 - a. Minimum Trade Size: Metric designator 21 (trade size 3/4).
 - b. Colors: As indicated on Drawings or in other Division 26, Division 27, and Division 28 Specification Sections.

2.4 TYPE FMC-S AND TYPE FMC-A DUCT RACEWAYS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN DXUZ; including UL 1.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.

C. UL DXUZ - Steel Flexible Metal Conduit (FMC-S):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Business.
 - b. Anaconda Sealtite; Anamet Electrical, Inc.
 - c. Electri-Flex Company.
 - d. International Metal Hose Co.
 - e. Penn Aluminum Conduit & EMT.
 - f. Topaz Lighting & Electric.
2. Material: Steel.
3. Options:
 - a. Minimum Trade Size: Metric designator 21 (trade size 3/4).
 - b. Colors: As indicated on Drawings or in other Division 26, Division 27, and Division 28 Specification Sections.

D. UL DXUZ - Aluminum Flexible Metal Conduit (FMC-A):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Business.
 - b. Anaconda Sealtite; Anamet Electrical, Inc.
 - c. Electri-Flex Company.
 - d. Topaz Lighting & Electric.
2. Options:
 - a. Minimum Trade Size: Metric designator 21 (trade size 3/4).

- b. Colors: As indicated on Drawings or in other Division 26, Division 27, and Division 28 Specification Sections.

2.5 TYPE LFMC DUCT RACEWAYS

A. Performance Criteria:

- 1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
- 2. Listing Criteria: UL CCN DXHR; including UL 360.

B. Source Quality Control:

- 1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.

C. UL DXHR - Steel Liquidtight Flexible Metal Conduit (LFMC-S):

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Business.
 - b. Anaconda Sealtite; Anamet Electrical, Inc.
 - c. Electri-Flex Company.
 - d. International Metal Hose Co.
- 2. Material: Steel.
- 3. Options:
 - a. Minimum Trade Size: Metric designator 21 (trade size 3/4).
 - b. Colors: As indicated on Drawings or in other Division 26, Division 27, and Division 28 Specification Sections.

2.6 TYPE LFNC DUCT RACEWAYS

A. Performance Criteria:

- 1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
- 2. Listing Criteria: UL CCN DXOQ; including UL 1660.

B. Source Quality Control:

- 1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.

C. UL DXOQ - Layered (Type A) Liquidtight Flexible Nonmetallic Conduit (LFNC-A):

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. AFC Cable Systems; Atkore International.
 - b. Electri-Flex Company.
 - c. Topaz Lighting & Electric.
 - 2. Additional Criteria: Type A conduit with smooth seamless inner core and cover bonded together with one or more reinforcement layers between core and cover.
 - 3. Options:
 - a. Minimum Trade Size: Metric designator 21 (trade size 3/4).
 - b. Colors: As indicated on Drawings or in other Division 26, Division 27, and Division 28 Specification Sections.
- D. UL DXOQ - Integral (Type B) Liquidtight Flexible Nonmetallic Conduit (LFNC-B):
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cambridge Resources.
 - b. Electri-Flex Company.
 - c. Superflex Ltd.
 - d. Topaz Lighting & Electric.
 - 2. Additional Criteria: Type B conduit with smooth inner surface with integral reinforcement within conduit wall.
 - 3. Options:
 - a. Minimum Trade Size: Metric designator 21 (trade size 3/4).
 - b. Colors: As indicated on Drawings or in other Division 26, Division 27, and Division 28 Specification Sections.

2.7 TYPE PVC DUCT RACEWAYS AND FITTINGS

- A. Performance Criteria:
- 1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
 - 2. Listing Criteria: UL CCN DZYR; including UL 651.
- B. Source Quality Control:
- 1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
- C. UL DZYR - Schedule 40 Rigid PVC Conduit (PVC-40) and Fittings:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Business.
 - b. Calconduit; Atkore International.
 - c. JM Eagle; J-M Manufacturing Co., Inc.
 - d. NAPCO; Westlake Chemical Corp.

- e. Opti-Com Manufacturing Network, Inc (OMNI).
 - f. Topaz Lighting & Electric.
2. Dimensional Specifications: Schedule 40.
 3. Options:
 - a. Minimum Trade Size: Metric designator 21 (trade size 3/4).

2.8 FITTINGS FOR CONDUIT, TUBING, AND CABLE

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.

C. UL DWTT - Fittings for Type ERM and Type PVC Duct Raceways:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Business.
 - b. Crouse-Hinds; brand of Eaton, Electrical Sector.
 - c. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
 - d. Konkore Fittings; Atkore International.
 - e. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
 - f. Penn Aluminum Conduit & EMT.
 - g. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - h. Southwire Company, LLC.
 - i. Topaz Lighting & Electric.
2. Listing Criteria: UL CCN DWTT; including UL 514B.
3. Options:
 - a. Material: Steel.
 - b. Coupling Method: Compression coupling.
 - c. Expansion and Deflection Fittings: UL 651 with flexible bonding jumper.

D. UL FKA V - Fittings for Type EMT Duct Raceways:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Business.
 - b. Allied Tube & Conduit; Atkore International.
 - c. Calconduit; Atkore International.
 - d. Crouse-Hinds; brand of Eaton, Electrical Sector.

- e. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
 - f. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
 - g. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - h. Southwire Company, LLC.
 - i. Topaz Lighting & Electric.
 - 2. Listing Criteria: UL CCN FKAV; including UL 514B.
 - 3. Options:
 - a. Material: Steel.
 - b. Coupling Method: Compression coupling or Setscrew coupling. Setscrew couplings with only single screw per conduit are unacceptable.
 - c. Expansion and Deflection Fittings: UL 651 with flexible bonding jumper.
- E. UL ILNR - Fittings for Type FMC Duct Raceways:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Fittings Corp. (AMFICO).
 - b. Liquid Tight Connector Co.
 - c. Southwire Company, LLC.
 - 2. Listing Criteria: UL CCN ILNR; including UL 514B.
- F. UL DXAS - Fittings for Type LFMC and Type LFNC Duct Raceways:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Liquid Tight Connector Co.
 - 2. Listing Criteria: UL CCN DXAS; including UL 514B.
- G. Rocky Mountain Power Conduit Sweep Applications:
- 1. Medium voltage, three phase primary: per Rocky Mountain Power sweeps must be constructed of fiberglass. Fiberglass conduit shall meet or exceed Rocky Mountain Power's material specification ZG033 "Fiberglass Conduit"
 - a. Each fiberglass sweep requires two factory-attached PVC, extra-deep, fabricated, expanded bell-ends.
 - b. Fiberglass sweeps must be certified by a NRTL
- 2.9 ELECTRICALLY CONDUCTIVE CORROSION-RESISTANT COMPOUNDS FOR THREADED CONDUIT
- A. Performance Criteria:
- 1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. Listing Criteria: UL CCN FOIZ; including UL Subject 2419.
- B. Source Quality Control:
1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
- C. UL FOIZ - Electrically Conductive Corrosion-Resistant Compound for Threaded Conduit:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Business.

PART 3 - EXECUTION

3.1 SELECTION OF CONDUITS FOR ELECTRICAL SYSTEMS

- A. Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NFPA 70 for selection of duct raceways. Consult Architect for resolution of conflicting requirements.
- B. Outdoors:
1. Exposed and Subject to Severe Physical Damage: ERMCM.
 2. Exposed and Subject to Physical Damage: ERMCM.
 3. Exposed and Not Subject to Physical Damage: ERMCM.
 4. Concealed Aboveground: EMT.
 5. Direct Buried: PVC-40 or HDPE-40 (where directional boring method is used).
 6. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFNC-A or LFNC-B.
- C. Indoors:
1. Hazardous Classified Locations: ERMCM.
 2. Exposed and Subject to Physical Damage: ERMCM. Locations include the following:
 - a. Loading docks.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Locations less than 10 ft above finished floor in the Manufacturing Area.
 3. Exposed and Not Subject to Physical Damage: EMT.
 4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 5. Damp or Wet Locations: ERMCM.
 6. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC or FMC.
- D. Duct Fittings: Select fittings in accordance with NEMA FB 2.10 guidelines.
1. ERMCM: Provide threaded-type fittings unless otherwise indicated.

3.2 INSTALLATION OF CONDUITS FOR ELECTRICAL SYSTEMS

- A. Comply with manufacturer's published instructions.
- B. Reference Standards for Installation: Unless more stringent installation requirements are specified in Contract Documents or manufacturers' published instructions, comply with the following:
 - 1. Type EMT-S: Article 358 of NFPA 70 and NECA NEIS 101.
 - 2. Type HDPE: Article 353 of NFPA 70 and NECA NEIS 111.
 - 3. Type ERMCS: Article 344 of NFPA 70 and NECA NEIS 101.
 - 4. Type FMC-S: Article 348 of NFPA 70 and NECA NEIS 101.
 - 5. Type FMC-A: Article 348 of NFPA 70 and NECA NEIS 102.
 - 6. Type LFMC: Article 350 of NFPA 70 and NECA NEIS 101.
 - 7. Type LFNC: Article 342 of NFPA 70 and NECA NEIS 111.
 - 8. Type PVC: Article 356 of NFPA 70 and NECA NEIS 111.
 - 9. Expansion Fittings: NEMA FB 2.40.
 - 10. Consult Engineer for resolution of conflicting requirements.
- C. Special Installation Techniques:
 - 1. General Requirements for Installation of Duct Raceways:
 - a. Complete duct raceway installation before starting conductor installation.
 - b. Provide stub-ups through floors with coupling threaded inside for plugs, set flush with finished floor. Plug coupling until conduit is extended above floor to final destination or a minimum of 2 ft above finished floor.
 - c. Install no more than equivalent of four 90-degree bends in conduit run. Support within 12 inch of changes in direction.
 - d. Make bends in duct raceway using large-radius preformed ells except for parallel bends. Field bending must be in accordance with NFPA 70 minimum radii requirements. Provide only equipment specifically designed for material and size involved.
 - e. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
 - f. Support conduit within 12 inch of enclosures to which attached.
 - g. Install duct sealing fittings at accessible locations in accordance with NFPA 70 and fill them with listed sealing compound. For concealed duct raceways, install fitting in flush steel box with blank cover plate having finish similar to that of adjacent plates or surfaces. Install duct sealing fittings in accordance with NFPA 70.
 - h. Install devices to seal duct raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal interior of duct 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 duct raceway enters a building or structure.
 - 3) Conduit extending from interior to exterior of building.
 - 4) Conduit extending into pressurized duct raceway 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.
 - i. Do not install conduits within 2 inch of the bottom side of a metal deck roof.

- j. Keep duct raceways at least 6 inch away from parallel runs of flues and steam or hot-water pipes. Install horizontal duct raceway runs above water and steam piping.
 - k. Cut conduit perpendicular to the length. For conduits metric designator 53 (trade size 2) and larger, use roll cutter or a guide to make cut straight and perpendicular to the length. Ream inside of conduit to remove burrs.
 - l. Install pull wires in empty duct raceways. Provide polypropylene or monofilament plastic line with not less than 200 lb tensile strength. Leave at least 12 inch of slack at both ends of pull wire. Cap underground duct raceways designated as spare above grade alongside duct raceways in use.
 - m. Install duct raceways square to the enclosure and terminate at enclosures without hubs with locknuts on both sides of enclosure wall. Install locknuts hand tight, plus one-quarter turn more.
 - 1) Termination fittings with shoulders do not require two locknuts.
 - n. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated throat metal bushings on all conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
2. Types FMC-A: Do not install aluminum duct raceways or fittings in contact with concrete or earth.
 3. Types ERM-C:
 - a. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound that maintains electrical conductivity to threads of duct raceway and fittings before making up joints. Follow compound manufacturer's published instructions.
 4. Types FMC, LFMC, and LFNC:
 - a. Provide a maximum of 36 inch of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
 5. Type PVC and HDPE:
 - a. Do not install Type PVC or Type HDPE conduit where ambient temperature exceeds 122 deg F. Conductor ratings must be limited to 75 deg C except where installed in a trench outside buildings with concrete encasement, where 90 deg C conductors are permitted.
 - b. Comply with manufacturer's published instructions for solvent and fittings.
 6. Duct Raceways Embedded in Slabs:
 - a. Run duct raceways larger than metric designator 27 (trade size 1) below concrete slab.
 - b. Arrange duct raceways to cross building expansion joints with expansion fittings at right angles to the joint.
 - c. Arrange duct raceways to ensure that each is surrounded by minimum of 1 inch of concrete without voids.
 - d. Do not embed threadless fittings in concrete unless locations have been specifically approved by Architect.

7. Stub-ups to Above Recessed Ceilings:
 - a. Provide EMT or ERM for duct raceways.
 - b. Provide a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
8. Duct Raceway Terminations at Locations Subject to Moisture or Vibration:
 - a. Provide insulating bushings to protect conductors, including conductors smaller than 4 AWG. Install insulated throat metal grounding bushings on service conduits.
9. Duct Fittings: Install fittings in accordance with NEMA FB 2.10 guidelines.
 - a. EMT: Provide compression, steel fittings. Comply with NEMA FB 2.10.
 - b. Flexible Conduit: Provide only fittings listed for use with flexible conduit type. Comply with NEMA FB 2.20.
10. Expansion-Joint Fittings:
 - a. Install in runs of aboveground PVC that are located where environmental temperature change may exceed 30 deg F and that have straight-run length that exceeds 25 ft. Install in runs of aboveground ERM and EMT conduit that are located where environmental temperature change may exceed 100 deg F and that have straight-run length that exceeds 100 ft.
 - b. Install type and quantity of fittings that accommodate temperature change listed for the following locations:
 - 1) Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
 - 2) Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
 - 3) Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
 - c. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F 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 of temperature change for metal conduits.
 - d. Install expansion fittings at locations where conduits cross building or structure expansion joints.
 - e. Install expansion-joint fitting with position, mounting, and piston setting selected in accordance with manufacturer's published instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
11. Duct Raceways Penetrating Rooms or Walls with Acoustical Requirements: Seal duct raceway openings on both sides of rooms or walls with acoustically rated putty or firestopping.
12. Identification: Provide labels for conduit assemblies, duct raceways, and associated electrical equipment.

D. Interfaces with Other Work:

1. Coordinate with Section 078413 "Penetration Firestopping" for installation of firestopping at penetrations of fire-rated floor and wall assemblies.
2. Coordinate with Section 260529 "Hangers and Supports for Electrical Systems" for installation of conduit hangers and supports.

3.3 INSTALLATION OF DIRECT-BURRIED CONDUITS

- A. Excavate trench bottom to provide firm and uniform support for conduit install backfill.
- B. 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 of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction.
- C. Install manufactured half-lap taped galvanized rigid steel (ERMC) duct elbows and sleeves for stub-ups at poles and equipment and at building entrances through floor slabs unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
 1. Couple steel conduits to ducts with adapters designed for this purpose.
 2. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
- D. Underground Warning Tape: Comply with requirements in Section 260533 "Identification for Electrical Systems."

3.4 ROCKY MOUNTAIN POWER RACEWAY METHODS:

- A. Comply with all requirement of the current six state ESR manual, the entire document can be found at the following web address for downloading and printing:
<http://www.rockymountainpower.net/esr>.
- B. The contractor shall provide all conduit systems for the required electrical utility work Provide 500 lb flat pull line or poly rope within each conduit. Proof all conduits with an 80% diameter mandrel witnessed by the Utility representative
- C. Per Rocky Mountain Power sweeps must be constructed of fiberglass. Fiberglass conduit shall meet or exceed Rocky Mountain Power's material specification ZG033 "Fiberglass Conduit"
 1. Each fiberglass sweep requires two factory-attached PVC, extra-deep, fabricated, expanded bell-ends.
 2. Fiberglass sweeps must be certified by a NRTL.
 3. Fiberglass conduit and sweeps must be black with three red stripes to identify electric conductors inside

- D. The contractor shall provide trenching, boring, backfill, compactions, and surface repair.
- E. The contractor shall provide pre-case concrete pad/vaults for utility provided transformers as required.

3.5 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 260533.13

SECTION 260533.16

BOXES AND COVERS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metallic outlet boxes, device boxes, rings, and covers.
2. Junction boxes and pull boxes.
3. Cover plates for device boxes.

B. Products Installed, but Not Furnished, under This Section:

1. See Section 260553 "Identification for Electrical Systems" for electrical equipment labels.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Metallic outlet boxes, device boxes, rings, and covers.
2. Junction boxes and pull boxes.
3. Cover plates for device boxes.

B. Shop Drawings:

1. Shop drawings for floor boxes.

PART 2 - PRODUCTS

2.1 METALLIC OUTLET BOXES, DEVICE BOXES, RINGS, AND COVERS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN QCIT; including UL 514A.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.

C. UL QCIT - Metallic Outlet Boxes and Covers:

1. Description: Box having pryout openings, knockouts, threaded entries, or hubs in either

the sides of the back, or both, for entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting outlet box cover, but without provisions for mounting wiring device directly to box.

2. Options:
 - a. Material: Sheet steel.
 - b. Sheet Metal Depth: Minimum 2.5 inch.

D. UL QCIT - Metallic Conduit Bodies:

1. Description: Means for providing access to interior of conduit or tubing system through one or more removable covers at junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.

E. UL QCIT - Metallic Device Boxes:

1. Description: Box with provisions for mounting wiring device directly to box.
2. Options:
 - a. Material: Sheet steel.
 - b. Sheet Metal Depth: minimum 2.5 inch.

F. UL QCIT - Metallic Extension Rings:

1. Description: Ring intended to extend sides of outlet box or device box to increase box depth, volume, or both.

G. UL QCIT - Metallic Floor Boxes and Floor Box Covers:

1. Description: Box mounted in floor with floor box cover and other components to complete floor box enclosure.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. FSR Inc.
 - b. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour; Legrand North America, LLC.
 - e. Wiremold; Legrand North America, LLC.

H. UL QCIT - Metallic Concrete Boxes and Covers:

1. Description: Box intended for use in poured concrete.

2.2 JUNCTION BOXES AND PULL BOXES

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. Listing Criteria: UL CCN BGUZ; including UL 50 and UL 50E.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.

C. UL BGUI - Indoor Sheet Metal Junction and Pull Boxes:

1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.

D. UL BGUI - Indoor Cast-Metal Junction and Pull Boxes:

1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.

E. UL BGUI - Outdoor Sheet Metal Junction and Pull Boxes:

1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.

F. UL BGUI - Outdoor Cast-Metal Junction and Pull Boxes:

1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.

2.3 COVER PLATES FOR DEVICES BOXES

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. Listing Criteria: UL CCN QCIT or UL CCN QCMZ; including UL 514D.
3. Wallplate-Securing Screws: Metal with head color to match wallplate finish.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.

C. UL QCIT or QCMZ - Metallic Cover Plates for Device Boxes:

1. Options:
 - a. Damp and Wet Locations: Listed, labeled, and marked for location and use. Provide gaskets and accessories necessary for compliance with listing.

2.4 HOODS FOR OUTLET BOXES

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. Listing Criteria:
 - a. UL CCN QCIT or UL CCN QCMZ; including UL 514D.

- b. Receptacle, Hood, Cover Plate, Gaskets, and Seals: UL 498 Supplement SA when mated with box or enclosure complying with UL 514A, UL 514C, or UL 50E.
- B. Source Quality Control:
 - 1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
- C. UL QCIT or QCMZ - Retractable or Reattachable Hoods for Outlet Boxes:
 - 1. Options:
 - a. Provides clear, weatherproof, "while-in-use" cover.

PART 3 - EXECUTION

3.1 SELECTION OF BOXES AND COVERS FOR ELECTRICAL SYSTEMS

- A. Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NFPA 70 for selection of boxes and enclosures. Consult Architect for resolution of conflicting requirements.
- B. Degree of Protection:
 - 1. Outdoors:
 - a. Type 3R unless otherwise indicated.
 - b. Locations Exposed to Hosedown: Type 4.
 - c. Locations Subject to Potential Flooding: Type 6P.
 - d. Locations Aboveground Where Mechanism Must Operate When Ice Covered: Type 3S.
 - e. Locations in-Ground or Exposed to Corrosive Agents: Type 4X .
 - f. Locations in-Ground or Exposed to Corrosive Agents Where Mechanism Must Operate When Ice Covered: Type 3SX.
 - 2. Indoors:
 - a. Type 1 unless otherwise indicated.
 - b. Damp or Dusty Locations: Type 12.
 - c. Surface Mounted in Kitchens and Other Locations Exposed to Oil or Coolants: Type 12.
 - d. Flush Mounted in Kitchens and Other Locations Exposed to Oil or Coolants: Type 12.
 - e. Locations Exposed to Airborne Dust, Lint, Fibers, or Flyings: Type 4.
 - f. Locations Exposed to Hosedown: Type 4.
 - g. Locations Exposed to Brief Submersion: Type 6.
 - h. Locations Exposed to Prolonged Submersion: Type 6P.
 - i. Locations Exposed to Corrosive Agents: Type 4X.
 - j. Locations Exposed to Spraying Oil or Coolants: Type 13.
- C. Exposed Boxes Installed Less Than 10 ft Above Floor:
 - 1. Provide cast-metal boxes.

2. Provide exposed cover. Flat covers with angled mounting slots or knockouts are prohibited.

3.2 INSTALLATION OF BOXES AND COVERS FOR ELECTRICAL SYSTEMS

- A. Comply with manufacturer's published instructions.
- B. Reference Standards for Installation: Unless more stringent installation requirements are specified in Contract Documents or manufacturers' published instructions, comply with the following:
 1. Outlet, Device, Pull, and Junction Boxes: Article 314 of NFPA 70.
 2. Consult Engineer for resolution of conflicting requirements.
- C. Special Installation Techniques:
 1. Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures.
 2. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
 3. 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, whether installed indoors or outdoors.
 4. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
 5. Locate boxes so that cover or plate will not span different building finishes.
 6. Support boxes in recessed ceilings independent of ceiling tiles and ceiling grid.
 7. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for purpose.
 8. Fasten junction and pull boxes to, or support from, building structure. Do not support boxes by conduits.
 9. Set metal floor boxes level and flush with finished floor surface.
 10. Do not install aluminum boxes, enclosures, or fittings in contact with concrete or earth.
 11. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to ensure a continuous ground path.
 12. Boxes and Enclosures in Areas or Walls with Acoustical Requirements:
 - a. Seal openings and knockouts in back and sides of boxes and enclosures with acoustically rated putty.
 - b. Provide gaskets for wallplates and covers.
 13. Identification: Provide labels for boxes and associated electrical equipment.
 - a. Identify field-installed conductors, interconnecting wiring, and components.
 - b. Identify circuit numbers.
 - c. Provide warning signs.
 - d. Label each box with engraved metal or laminated-plastic nameplate.

3.3 CLEANING

- A. Remove construction dust and debris from boxes before installing wallplates, covers, and hoods.

3.4 PROTECTION

- A. After installation, protect boxes from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 260533.16

SECTION 260548.16

SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

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.

B. Related Requirements:

1. Section 260529 "Hangers and Supports for Electrical Systems" for commonly used electrical supports and installation requirements.

1.2 DEFINITIONS

- ###### A.
- OSHPD: Office of Statewide Health Planning and Development (for the State of California owned and regulated medical facilities).

1.3 COORDINATION

A. Tests and Inspections:

1. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and provide notice at least seven days in advance.
2. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Restraints - rigid type.
2. Restraints - cable type.
3. Restraint accessories.
4. Post-installed concrete anchors.
5. Concrete inserts.

B. Shop Drawings: Show coordination of seismic and wind-load bracing for components with other

systems and equipment in the vicinity, including other supports and seismic restraints.

- C. Delegated Design Submittal for Each Seismic-Restraint Device: Signed and sealed by qualified structural professional engineer licensed in Utah.
 - 1. For each seismic-restraint device, including restraint - rigid and cable type, restraint accessory, and concrete anchor and insert that is required by this Section or is indicated on Drawings, submit the following:
 - a. Seismic Restraints: Select seismic restraints complying with performance requirements, design criteria, and analysis data.
 - b. Post-Installed Concrete Anchors and Inserts: Include calculations showing anticipated seismic loads. Include certification that device is approved by qualified testing laboratory for seismic reinforcement use.
 - c. Seismic Design Calculations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified structural professional engineer to design seismic control system.
- B. SeismicRestraint Device Load Ratings: Devices to be tested and rated in accordance with applicable code requirements and authorities having jurisdiction.
- C. Component Supports:
 - 1. Load ratings, features, and applications of all reinforcement components must be based on testing standards of qualified testing laboratory.

2.2 RESTRAINTS - RIGID TYPE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. CADDY; brand of nVent Electrical plc.
 - 2. California Dynamics Corporation.
 - 3. Cooper B-line; brand of Eaton, Electrical Sector.
 - 4. Hilti, Inc.
 - 5. Isolation Technology, Inc.
 - 6. TOLCO Incorporated.
 - 7. Unistrut; Atkore International.
 - 8. VMC GROUP.
- B. Description: Shop- or field-fabricated bracing assembly made of ANSI/AISI S110-07-S1 slotted steel channels, ANSI/ASTM A53/A53M steel pipe, 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. CADDY; brand of nVent Electrical plc.
 - 2. Cooper B-line; brand of Eaton, Electrical Sector.
 - 3. Gripple Inc.
 - 4. Loos & Co. Inc.
 - 5. VMC GROUP.
- B. Seismic- and Wind-Load-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 and cable fittings must comply with ASCE/SEI 19. 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. CADDY; brand of nVent Electrical plc.
 - 2. Cooper B-line; brand of Eaton, Electrical Sector.
 - 3. Hilti, Inc.
 - 4. Loos & Co. Inc.
 - 5. Mason Industries, Inc.
 - 6. TOLCO Incorporated.
 - 7. Unistrut; Atkore International.
- B. Hanger-Rod Stiffener: Reinforcing steel angle clamped 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.

2.5 POST-INSTALLED CONCRETE ANCHORS

A. Mechanical Anchor Bolts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cooper B-line; brand of Eaton, Electrical Sector.
 - b. Hilti, Inc.
 - c. Mason Industries, Inc.
 - d. Powers Fasteners.
 - e. Simpson Strong-Tie Co., Inc.
 - f. Unistrut; Atkore International.
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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cooper B-line; brand of Eaton, Electrical Sector.
 - b. Hilti, Inc.
 - c. Mason Industries, Inc.
 - d. Powers Fasteners.
 - e. Simpson Strong-Tie Co., Inc.
 - f. Unistrut; Atkore International.
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 and wind-load applications.

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.

2.6 CONCRETE INSERTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper B-line; brand of Eaton, Electrical Sector.
2. Hilti, Inc.
3. Mason Industries, Inc.
4. Powers Fasteners.
5. Simpson Strong-Tie Co., Inc.

- 6. Unistrut; Atkore International.
- B. Provide preset concrete inserts that are seismically prequalified in accordance with ICC-ES AC446 testing.
- C. Comply with MSS SP-58.

2.7 SOURCE QUALITY CONTROL

- A. Product Data: Prepare and submit catalog cuts, brochures, diagrams, schedules, and performance data illustrating size, physical appearance, and other characteristics of product.
 - 1. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-load-restraint component used.
 - 2. 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.
 - 3. Annotate to indicate application of each product submitted and compliance with requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive seismic and wind-load control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for 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 evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction.
- B. Hanger-Rod Stiffeners: Install where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods caused by seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry static, wind load, and seismic loads within specified loading limits.

3.3 INSTALLATION OF SEISMIC-RESTRAINT AND WIND-LOAD CONTROL DEVICES

- A. Provide seismic-restraint and wind-load control devices for systems and equipment where indicated in Equipment Schedules or Seismic and Wind-Load Controls Schedule, where indicated on Drawings, where the Specifications indicate they are to be installed on specific equipment and systems, and where required by applicable codes.
 - 1. Install equipment and devices to withstand the effects of earthquake motions and high wind events.
- B. 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."
- C. Installation of seismic and wind-load restraints must not cause any stresses, misalignment, or change of position of equipment or conduits.
- D. Equipment Restraints:
 - 1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
 - 2. Install seismic-restraint and wind-load-restraint devices using methods approved by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction that provides required submittals for component.
- E. Raceway, Cable, Wireway, Cable Tray, and Busway Support and Hanger Restraints:
 - 1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
 - 2. Install seismic-restraint and wind-load-restraint devices using methods approved by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction that provides required submittals for component.
- F. Equipment and Hanger Restraints:
 - 1. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
 - 2. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction providing required submittals for component.
- G. Install cables so they do not bend across edges of adjacent equipment or building structure.
- H. 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.
- I. 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.
- J. 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-Type Anchor Bolts: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors must be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 4. Adhesive-Type 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 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 connection is terminated to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.5 FIELD QUALITY CONTROL

- A. Field tests must be witnessed by authorities having jurisdiction.
- B. Tests and Inspections:
 1. Test no fewer than four of each type and size of installed anchors and fasteners selected by Architect.
 2. Test to 90 percent of rated proof load of device.
- C. Field Quality-Control Reports: Collect, assemble, and submit test and inspection reports.

END OF SECTION 260548.16

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SECTION 260553

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Labels.
2. Bands and tubes.
3. Tapes and stencils.
4. Tags.
5. Signs.
6. Cable ties.
7. Miscellaneous identification products.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Labels.
2. Bands and tubes.
3. Tapes and stencils.
4. Tags.
5. Signs.
6. Cable ties.
7. Miscellaneous identification products.

- B. Identification Schedule: For each piece of electrical equipment and electrical system components to be index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with ASME A13.1 and IEEE C2.

- B. Comply with 29 CFR 1910.144 for color identification of hazards; 29 CFR 1910.145 for danger, caution, warning, and safety instruction signs and tags; and the following:

1. Fire-alarm equipment, including raceways, must be finished, painted, or suitably marked safety red.

- C. Signs, labels, and tags required for personnel safety must comply with the following standards:

1. Safety Colors: NEMA Z535.1.

2. Facility Safety Signs: NEMA Z535.2.
 3. Safety Symbols: NEMA Z535.3.
 4. Product Safety Signs and Labels: NEMA Z535.4.
 5. Safety Tags and Barricade Tapes for Temporary Hazards: NEMA Z535.5.
- D. Comply with NFPA 70E and Section 260673 "Protection Device Study" requirements for arc-flash warning labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, must comply with UL 969.
- F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 COLOR AND LEGEND REQUIREMENTS

- A. Color-Coding for Phase- and Voltage-Level Identification, 1000 V or Less: Refer to Section 260519 "Low-Voltage Electrical Conductors and Cables."
1. Color must be factory applied or field applied for sizes larger than 8 AWG if authorities having jurisdiction permit.
- B. Warning labels and signs must include, but are not limited to, the following legends:
1. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR ___ FEET MINIMUM." Refer to NFPA 70, Table 110.26(A)(1) for exact workspace clearance requirements.
- C. Equipment Identification Labels:
1. Normal Power: Black letters on white background
 2. Emergency Power: White letters on red background
 3. Standby Power: Black letters on orange background

2.3 LABELS

- A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.
- B. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.
- C. Self-Adhesive Wraparound Labels: Preprinted, 3 mil thick, vinyl flexible label with acrylic pressure-sensitive adhesive.
1. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over legend. Labels sized such that clear shield overlaps entire printed legend.
 2. Marker for Labels:
 - a. Permanent, waterproof, black ink marker recommended by tag manufacturer.

- D. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3 mil thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.

- 1. Minimum Nominal Size:

- a. 3-1/2 by 5 inch for equipment.

2.4 BANDS AND TUBES

- A. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inch long, with diameters sized to suit diameters and that stay in place by gripping action.
- B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at maximum of 200 deg F. Comply with UL 224.

2.5 TAPES AND STENCILS

- A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mil thick by 1 to 2 inch wide; compounded for outdoor use.
- C. Tape and Stencil: 4 inch wide black stripes on 10 inch centers placed diagonally over orange background and are 12 inch wide. Stop stripes at legends.
- D. Floor Marking Tape: 2 inch wide, 5 mil pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.
- E. Underground-Line Warning Tape:
 - 1. Tape:
 - a. Recommended by manufacturer for method of installation and suitable to identify and locate underground electrical and communications utility lines.
 - b. Printing on tape must be permanent and may not be damaged by burial operations.
 - c. Tape material and ink must be chemically inert and not be subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
 - 2. Color and Printing:
 - a. Comply with APWA Uniform Color Code using NEMA Z535.1 safety colors.
 - b. Inscriptions for Red Tapes: "CAUTION BURIED ELECTRIC LINE BELOW".
 - c. Inscriptions for Orange Tapes: "CAUTION BURIED COMMUNICATION LINE BELOW".
- F. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height must be 1 inch.

2.6 TAGS

- A. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.

2.7 SIGNS

- A. Laminated Acrylic or Melamine Plastic Signs:
 - 1. Engraved legend.
 - 2. Thickness:
 - a. For signs up to 20 sq. inch, minimum 1/16 inch thick.
 - b. For signs larger than 20 sq. inch, 1/8 inch thick.
 - c. Engraved legend with black letters on white face.
 - d. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.8 CABLE TIES

- A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
 - 1. Minimum Width: 3/16 inch.
 - 2. Tensile Strength at 73 deg F in accordance with ASTM D638: 12,000 psi.
 - 3. Temperature Range: Minus 40 to plus 185 deg F.
 - 4. Color: Black, except where used for color-coding.

2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain 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 PREPARATION

- A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

- B. Install identifying devices before installing acoustical ceilings and similar concealment.
- C. Verify identity of item before installing identification products.
- D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- E. Apply identification devices to surfaces that require finish after completing finish work.
- F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.
- G. System Identification for Raceways and Cables under 1000 V: Identification must completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
 - 1. Secure tight to surface of conductor, cable, or raceway.
- H. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
- I. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from floor.
- J. Accessible Fittings for Raceways: Identify cover of junction and pull box of the following systems with wiring system legend and system voltage. System legends must be as follows:
 - 1. "POWER."
 - 2. "COMMUNICATION."
 - 3. "SECURITY."
 - 4. "FIRE ALARM."
- K. Vinyl Wraparound Labels:
 - 1. Secure tight to surface of raceway or cable at location with high visibility and accessibility.
 - 2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to location and substrate.
- L. Snap-Around Labels: Secure tight to surface at location with high visibility and accessibility.
- M. Self-Adhesive Wraparound Labels: Secure tight to surface at location with high visibility and accessibility.
- N. Self-Adhesive Labels:
 - 1. Install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
 - 2. Unless otherwise indicated, provide single line of text with 1/2 inch high letters on 1-1/2 inch high label; where two lines of text are required, use labels 2 inch high.
- O. Snap-Around Color-Coding Bands: Secure tight to surface at location with high visibility and accessibility.
- P. Heat-Shrink, Preprinted Tubes: Secure tight to surface at location with high visibility and accessibility.

- Q. Marker Tapes: Secure tight to surface at location with high visibility and accessibility.
- R. Self-Adhesive Vinyl Tape: Secure tight to surface at location with high visibility and accessibility.
 - 1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for minimum distance of 6 inch where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.
- S. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.
- T. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's instructions.
- U. Nonmetallic Preprinted Tags:
 - 1. Place in location with high visibility and accessibility.
 - 2. Secure using [general-purpose] [UV-stabilized] [plenum-rated] cable ties.
- V. Write-on Tags:
 - 1. Place in location with high visibility and accessibility.
 - 2. Secure using [general-purpose] [UV-stabilized] [plenum-rated] cable ties.
- W. Laminated Acrylic or Melamine Plastic Signs:
 - 1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to location and substrate.
 - 2. Unless otherwise indicated, provide single line of text with 1/2 inch high letters on 1-1/2 inch high sign; where two lines of text are required, use labels 2 inch high.
- X. Cable Ties: General purpose, for attaching tags, except as listed below:
 - 1. Outdoors: UV-stabilized nylon.
 - 2. In Spaces Handling Environmental Air: Plenum rated.

3.3 IDENTIFICATION SCHEDULE

- A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.
- B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.
- C. Accessible Fittings for Raceways and Cables within Buildings: Identify cover of junction and pull box of the following systems with self-adhesive labels containing wiring system legend and system voltage. System legends must be as follows:
 - 1. "POWER."
 - 2. "COMMUNICATION."
 - 3. "SECURITY".
 - 4. "FIRE ALARM."

- D. Power-Circuit Conductor Identification, 1000 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use vinyl wraparound labels or self-adhesive wraparound labels to identify phase.
 - 1. Locate identification at changes in direction, at penetrations of walls and floors, at 50 ft maximum intervals in straight runs, and at 25 ft maximum intervals in congested areas.
- E. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive labels with conductor or cable designation, origin, and destination.
- F. Auxiliary Electrical Systems Conductor Identification: Self-adhesive vinyl tape that is uniform and consistent with system used by manufacturer for factory-installed connections.
 - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
- G. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.
- H. Workspace Indication: Apply floor marking tape to finished surfaces. Show working clearances in direction of access to live parts. Workspace must comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- I. Instructional Signs: Self-adhesive labels, including color code for grounded and ungrounded conductors.
- J. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive labels.
 - 1. Apply to exterior of door, cover, or other access.
- K. Arc Flash Warning Labeling: Self-adhesive labels.
- L. Operating Instruction Signs: Self-adhesive labels.
- M. Equipment Identification Labels:
 - 1. Indoor Equipment: Laminated acrylic or melamine plastic sign.
 - 2. Outdoor Equipment: Laminated acrylic or melamine sign.
 - 3. Equipment to Be Labeled:
 - a. Panelboards: Typewritten directory of circuits in location provided by panelboard manufacturer. Panelboard identification must be in form of self-adhesive, engraved, laminated acrylic or melamine label.
 - b. Enclosures and electrical cabinets.
 - c. Access doors and panels for concealed electrical items.
 - d. Switchboards.
 - e. Transformers: Label that includes tag designation indicated on Drawings for transformer, feeder, and panelboards or equipment supplied by secondary.
 - f. Emergency system boxes and enclosures.
 - g. Enclosed switches.
 - h. Enclosed circuit breakers.
 - i. Enclosed controllers.

- j. Push-button stations.
- k. Power-transfer equipment.
- l. Contactors.
- m. Remote-controlled switches, dimmer modules, and control devices.
- n. Power-generating units.
- o. Monitoring and control equipment.

END OF SECTION 260553

SECTION 260673

PROTECTIVE DEVICE STUDY

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes computer-based, fault-current and overcurrent protective device coordination studies. Protective devices shall be set based on results of the protective device coordination study.
 - 1. Coordination of series-rated devices is permitted where indicated on Drawings.

1.2 SUBMITTALS

- A. Product Data: For computer software program to be used for studies.
- B. Product Certificates: For coordination-study and fault-current-study computer software programs, certifying compliance with IEEE 399.
- C. Qualification Data: For coordination-study specialist.
- D. Other Action Submittals: The following submittals shall be made after the approval process for system protective devices has been completed.
 - 1. Coordination-study input data, including completed computer program input data sheets.
 - 2. Study and Equipment Evaluation Reports.
 - 3. Coordination-Study Report.

1.3 SUBMITTALS FOR CONSTRUCTION

- A. The results of the short-circuit, protective device coordination and arc flash hazard analysis studies shall be summarized in a final report. No more than five(5) bound copies of the complete final report shall be submitted. For large system studies, submittals requiring more than five (5) copies of report will be provided without the section containing the computer printout of the short-circuit input and output data. Additional copies of the short-circuit input and output data, where required, shall be provided on CD in PDF format.
- B. For large system studies with more than 200 bus locations, the contractor is required to provide the study project files to the owner in electronic format. In addition, a copy of the computer analysis software viewer program is required to accompany the electronic project files, to allow the owner to review all aspects of the project and print arc flash labels, one-line diagrams, and other items.
- C. The report shall include the following sections:
 - 1. Executive summary
 - 2. Descriptions, purpose, basis, and scope of the study

3. Tabulations of circuit breaker, fuse, and other protective device rating versus calculated short circuit duties
4. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip unit settings, fuse selection
5. Fault current calculations, including a definition of terms and guide for interpretation of the computer printout
6. Details of the incident energy and flash protection boundary calculations
7. Recommendations for system improvements, where needed
8. One-line diagram

D. Arc flash labels shall be provided in hard copy only.

1.4 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 not acceptable.
- B. Coordination-Study Specialist Qualifications: An entity experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
 1. Professional engineer, licensed in the state where Project is located, shall be responsible for the study. All elements of the study shall be performed under the direct supervision and control of engineer.
- C. The equipment manufacturer or approved engineering firm shall demonstrate experience with arc flash hazard analysis by submitting names of at least ten actual arc flash hazard analyses it has performed in the past year.
- D. The contractor shall furnish an arc flash hazard analysis study, per the requirements set forth in NFPA 70E "" Standard for Electrical Safety in the Workplace. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2004, Annex D.
- E. Comply with IEEE 242 for short-circuit currents and coordination time intervals.
- F. Comply with IEEE 399 for general study procedures.
- G. Comply with 1584 "" Guide for Performing Arc-Flash Hazard Calculations.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

- A. Available Computer Software Developers: Subject to compliance with requirements, companies offering computer software programs that may be used in the Work include, but are not limited to, the following:
 1. EDSA Micro Corporation.
 2. SKM Systems Analysis, Inc.

2.2 COMPUTER SOFTWARE PROGRAM REQUIREMENTS

- A. Comply with IEEE 399.
- B. Analytical features of fault-current-study computer software program shall include "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- C. 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.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.
 - 1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

3.2 POWER SYSTEM DATA

- A. Gather and tabulate the following input data to support coordination study:
 - 1. Product Data for overcurrent protective devices specified in other Division 26 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. Impedance of utility service entrance.
 - 3. Electrical Distribution System Diagram: In hard-copy and electronic-copy formats, showing the following:
 - a. Circuit-breaker and fuse-current ratings and types.
 - b. Relays and associated power and current transformer ratings and ratios.
 - c. Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios.
 - d. Generator kilovolt amperes, size, voltage, and source impedance.
 - e. Cables: Indicate conduit material, sizes of conductors, conductor material, insulation, and length.
 - f. Busway ampacity and impedance.

- g. Motor horsepower and code letter designation according to NEMA MG 1.
- 4. 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 interrupting rating in amperes rms symmetrical.

3.3 FAULT-CURRENT STUDY

- A. Calculate the maximum available short-circuit current in amperes rms symmetrical at circuit-breaker positions of the electrical power distribution system. The calculation shall be for a current immediately after initiation and for a three-phase bolted short circuit at each of the following:
 - 1. Switchgear and switchboard bus.
 - 2. Medium-voltage controller.
 - 3. Motor-control center.
 - 4. Distribution panelboard.
 - 5. Branch circuit panelboard.
- B. 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.
- C. Calculate momentary and interrupting duties on the basis of maximum available fault current.
- D. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with IEEE 141 and IEEE 242.
 - 1. Transformers:
 - a. ANSI C57.12.10.
 - b. ANSI C57.12.22.
 - c. ANSI C57.12.40.
 - d. IEEE C57.12.00.
 - e. IEEE C57.96.

2. Medium-Voltage Circuit Breakers: IEEE C37.010.
3. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.20.1.
4. Low-Voltage Fuses: IEEE C37.46.

E. Study Report:

1. Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram.
2. Show interrupting (5-cycle) and time-delayed currents (6 cycles and above) on medium-voltage breakers as needed to set relays and assess the sensitivity of overcurrent relays.

F. Equipment Evaluation Report:

1. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
2. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
3. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

3.4 COORDINATION STUDY

A. Perform coordination study using approved computer software program. Prepare a written report using results of fault-current study. Comply with IEEE 399.

1. Calculate the maximum and minimum 1/2-cycle short-circuit currents.
2. Calculate the maximum and minimum interrupting duty (5 cycles to 2 seconds) short-circuit currents.
3. Calculate the maximum and minimum ground-fault currents.

B. Comply with IEEE 141 and recommendations for fault currents and time intervals.

C. 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.

D. Motors served by voltages more than 600 V shall be protected according to IEEE 620.

E. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves 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.

- F. Coordination-Study Report: Prepare a written report indicating the following results of coordination study:
1. Tabular Format of Settings Selected for Overcurrent Protective Devices:
 - a. Device tag.
 - b. Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup values.
 - c. Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.
 - d. Fuse-current rating and type.
 - e. Ground-fault relay-pickup and time-delay settings.
 2. Coordination Curves: Prepared to 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:
 - a. Device tag.
 - b. Voltage and current ratio for curves.
 - c. Three-phase and single-phase damage points for each transformer.
 - d. No damage, melting, and clearing curves for fuses.
 - e. Cable damage curves.
 - f. Transformer inrush points.
 - g. Maximum fault-current cutoff point.
- G. Completed data sheets for setting of overcurrent protective devices.

3.5 ARC FLASH HAZARD ANALYSIS

- A. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2004, Annex D.
- B. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboards, busway, and splitters) where work could be performed on energized parts.
- C. The arc flash hazard analysis shall include all panelboard locations down to 240 volt and 208 volt systems, where work could be performed on energized parts.
- D. Safe working distances shall be based upon the calculated arc flash boundary, considering an incident energy of 1.2 cal/cm².
- E. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations.

- F. The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum and will assume a minimum motor contribution (all motors off). Conversely, the maximum calculation will assume a maximum contribution from the utility and will assume the maximum amount of motors to be operating. Calculations shall take into considering the parallel operation of synchronous generators with the electric utility, where applicable.
- G. The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators should be decremented as follows.
 - 1. Fault contribution from induction motors should not be considered beyond 3-5 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 3 per unit after 10 cycles).
- H. For each equipment location with a separately enclosed main device (where there is adequate separation between the line side terminals of the main protective device and the work location), calculations for incident energy and flash protection boundary shall include both the line and load side of the main breaker.
- I. When performing incident energy calculations on the line side of a main breaker, as required above, the line side and load side contributions must be included in the fault calculation.
- J. Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.
- K. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds, based on IEEE 1584-2002 section B.1.2. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.

3.6 ARC FLASH WARNING LABELS

- A. The contractor of the arc flash hazard analysis shall provide a 3.5 inch x 5 inch thermal transfer-type label of high adhesion polyester for each work location analyzed.
- B. All labels will be based on recommended overcurrent device setting and will be provided after the results of the analysis have been presented to the owner, and after any system changes, upgrades, or modifications have been incorporated in the system.
- C. The label shall include the following information, at a minimum:
 - 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

- D. Labels shall be machine-printing, with no field markings.
- E. Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings.
1. For each 600, 480, and applicable 208 volt panelboard, one arc flash label shall be provided.
 2. For each motor control center, one arc flash label shall be provided.
 3. For each low-voltage switchboard, one arc flash label shall be provided.
 4. For each switchgear, one arc flash label shall be provided.
 5. For medium voltage switches, one arc flash label shall be provided.
- F. Labels shall be field-installed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.

3.7 ARC FLASH TRAINING

- A. The contractor of the arc flash hazard analysis shall train the owner's qualified electrical personnel of the potential arc flash hazards associated with working on energized equipment (minimum of 4 hours). The training shall be certified for continuing education units (CEUs) by the International Association for Continuing Education Training (IACET), or equivalent.

END OF SECTION 260673

SECTION 260923
LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Outdoor photoelectric switches, solid state, luminaire-mounted.
2. Daylight-harvesting dimming controls, digital.
3. Indoor occupancy and vacancy sensors.
4. High-bay occupancy sensors.
5. Conductors and cables.

B. Related Requirements:

1. Section 262726 "Wiring Devices" for wall-box dimmers, non-networkable wall-switch occupancy sensors, and manual light switches.

1.2 ACTION SUBMITTALS

A. Shop Drawings:

1. Show installation details for the following:
 - a. Occupancy sensors.
 - b. Vacancy sensors.
2. Interconnection diagrams showing field-installed wiring.
3. Include diagrams for power, signal, and control wiring.

B. Field quality-control reports.

1.3 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For manufacturer's warranties.

1.4 WARRANTY

A. Warranty: Manufacturer and Installer warrant that installed lighting control devices perform in accordance with specified requirements and agree to repair or replace, including labor, materials, and equipment, devices that fail to perform as specified within extended warranty period.

1. Failures include, but are not limited to, the following:
 - a. Faulty operation of lighting control software.

- b. Faulty operation of lighting control devices.
- 2. Warranty Period: Two year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 DAYLIGHT-HARVESTING DIMMING CONTROLS, DIGITAL

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Lithonia Lighting; Acuity Brands Lighting, Inc.
 - 2. WattStopper; Legrand North America, LLC.
 - 3. Cooper Lighting Controls.
- B. Description: Sensing daylight and electrical lighting levels, the system adjusts the indoor electrical lighting levels. As daylight increases, lights are dimmed.
 - 1. Lighting control set point is based on the following two lighting conditions:
 - a. When no daylight is present (target level).
 - b. When significant daylight is present.
 - 2. System programming is done with two hand-held, remote-control tools.
 - a. Initial setup tool.
 - b. Tool for occupants to adjust the target levels by increasing the set point up to 25 percent, or by minimizing the electric lighting level.
- C. Ceiling-Mounted Dimming Controls: Solid-state, light-level sensor unit, with separate power pack, to detect changes in indoor lighting levels that are perceived by the eye.
- D. Electrical Components, Devices, and Accessories:
 - 1. Listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
 - 2. Sensor Output: zero to 10 V(dc) to operate luminaires. Sensor is powered by controller unit.
 - 3. Light-Level Sensor Set-Point Adjustment Range: 20 to 60 fc.
- E. Power Pack: Digital controller capable of accepting RJ45 inputs with one or two output(s) rated for 20 A LED load at 120 and 277 V(ac). Sensor has 24 V(dc) Class 2 power source.
 - 1. With integral current monitoring.
 - 2. Compatible with digital addressable lighting interface.
 - 3. Plenum rated.

2.2 INDOOR OCCUPANCY AND VACANCY SENSORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Lithonia Lighting; Acuity Brands Lighting, Inc.
2. WattStopper; Legrand North America, LLC.
3. Cooper Lighting Controls.

B. General Requirements for Sensors:

1. Ceiling-mounted, solid-state indoor [occupancy] [and] [vacancy] sensors.
2. Dual technology.
3. Separate power pack.
4. Hardwired connection to switch.
5. Listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
6. Operation:
 - a. Combination Sensor: Unless otherwise indicated, sensor must be programmed to turn lights on when coverage area is occupied and turn them off when unoccupied, or to turn off lights that have been manually turned on; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
7. Sensor Output: Sensor is powered from the power pack.
8. Power Pack: Dry contacts rated for 20 A LED load at 120 and 277 V(ac). Sensor has 24 V(dc), 150 mA, Class 2 power source.
9. Mounting:
 - a. Sensor: Suitable for mounting in any position in a standard device box or outlet box.
10. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
11. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; turn lights off when selected lighting level is present.

C. Dual-Technology Type: Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 6 inch minimum movement of any portion of a human body that presents a target of not less than 36 sq. inch, and detect a person of average size and weight moving not less than 12 inch in either a horizontal or a vertical manner at an approximate speed of 12 inch/s.
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96 inch high ceiling.
4. Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180-degree pattern centered on the sensor over an area of 3000 sq. ft. when mounted 48 inch above finished floor.

2.3 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Lithonia Lighting; Acuity Brands Lighting, Inc.

2. WattStopper; Legrand North America, LLC.
 3. Cooper Lighting Controls.
- B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor with manual on-off switch, suitable for mounting in a single gang switchbox[, with provisions for connection to BAS] [using hardwired connection] [using wireless connection].
1. Listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application[, and must comply with California Title 24].
 2. Occupancy Sensor Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn lights off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 3. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
 4. Switch Rating: Not less than 800 VA LED load at 120 V and 1200 VA LED load at 277 V.
- C. Wall-Switch:
1. Standard Range: 180-degree field of view, field adjustable from 180 to 40 degrees; with a minimum coverage area of 2100 sq. ft..
 2. Sensing Technology: Dual technology - PIR and ultrasonic.
 3. Capable of controlling load in three-way application.
 4. Voltage: Match the circuit voltage.
 5. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc. The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
 6. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
 7. Color: White.
 8. Faceplate: Color matched to switch.

2.4 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.
- B. Examine walls and ceilings for suitable conditions where lighting control devices will be

installed.

- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF SENSORS

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.
- B. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's instructions.

3.3 INSTALLATION OF WIRING

- A. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch.
- B. Wiring within Enclosures: Separate power-limited and nonpower-limited conductors in accordance with conductor manufacturer's instructions.
- C. Size conductors in accordance with lighting control device manufacturer's instructions unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, device, and outlet boxes; terminal cabinets; and equipment enclosures.

3.4 IDENTIFICATION

- A. Identify components and power and control wiring in accordance with Section 260553 "Identification for Electrical Systems."
 - 1. Identify controlled circuits in lighting contactors.
 - 2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.

3.5 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Nonconforming Work:
 - 1. Lighting control devices will be considered defective if they do not pass tests and inspections.
 - 2. Remove and replace defective units and retest.

- C. Prepare test and inspection reports.

3.6 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting lighting control devices to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.
 - 1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
 - 2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.
 - 3. Align high-bay occupancy sensors using manufacturer's laser aiming tool.

3.7 DEMONSTRATION

- A. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control systems specified in Section 260943.23 "Relay-Based Lighting Controls."
- B. Train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION 260923

SECTION 260943.23

RELAY-BASED LIGHTING CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Lighting control relay panels.
 - 2. Conductors and cables.

1.2 DEFINITIONS

- A. Monitoring: Acquisition, processing, communication, and display of equipment status data, metered electrical parameter values, power quality evaluation data, event and alarm signals, tabulated reports, and event logs.

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for control modules, power distribution components, relays, manual switches and cover plates, and conductors and cables.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For each relay panel 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 Type 1.
 - 3. Detail wiring partition configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of relays.
 - 5. Address Drawing: Reflected ceiling plan and floor plans, showing connected luminaires, address for each luminaire, and luminaire groups. Base plans on construction plans, using the same legend, symbols, and schedules.
 - 6. Point List and Data Bus Load: Summary list of all control devices, sensors, ballasts, and other loads. Include percentage of rated connected load and device addresses.
 - 7. Wire Termination Diagrams and Schedules: Coordinate nomenclature and presentation with Drawings and block diagram. Differentiate between manufacturer-installed and field-installed wiring.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Handle and prepare panels for installation in accordance with NECA 407.

1.5 WARRANTY

- A. Warranty: Manufacturer warrants that components of standalone multipreset modular dimming controls perform in accordance with specified requirements and agrees to provide repair or replacement of components that fail to perform as specified within extended warranty period.
 - 1. Warranty Period: Two year(s) from date of Substantial Completion, for labor, materials, and equipment.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Sequence of Operations: Input signal from field-mounted manual switches, or digital signal sources, must open or close one or more lighting control relays in the lighting control panels. Any combination of inputs must be programmable to any number of control relays.
- B. Surge Protective Device: Factory installed as an integral part of control components or field-mounted surge suppressors complying with UL 1449, SPD Type 2.
- C. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70 by qualified electrical testing laboratory recognized by authorities having jurisdiction and marked for intended location and application.
- D. Comply with 47 CFR 15, Subparts A and B, for Class A digital devices.
- E. Comply with UL 916.

2.2 LIGHTING CONTROL RELAY PANELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Leviton Manufacturing Co., Inc.
 - 2. Lithonia Lighting; Acuity Brands Lighting, Inc.
 - 3. WattStopper; Legrand North America, LLC.
 - 4. Cooper Lighting Controls.
- B. Description: Standalone lighting control panel using mechanically latched relays to control lighting and appliances.
- C. Lighting Control Panel:
 - 1. A single enclosure with incoming lighting branch circuits, control circuits, switching relays, and on-board timing and control unit.
 - 2. A vertical barrier separating branch circuits from control wiring.
- D. Control Unit: Contain the power supply and electronic control for operating and monitoring individual relays.
 - 1. Timing Unit:

- a. 365-day calendar, astronomical clock, and automatic adjustments for daylight savings and leap year.
- b. Clock configurable for 12-hour (A.M./P.M.) or 24-hour format.
- c. Four independent schedules, each having 24 time periods.
- d. Schedule periods settable to the minute.
- e. Day-of-week, day-of-month, day-of-year with one-time or repeating capability.
- f. 10 special date periods.

E. Relays:

- 1. Electrically operated, mechanically held single-pole switch, rated at 20 A at 277 V. Short-circuit current rating must be not less than 5 kA. Control must be three-wire, 24 V(ac).

F. Power Supply: NFPA 70, Class 2, sized for connected equipment, plus 20 percent spare capacity. Powered from a dedicated branch circuit of the panelboard that supplies power to the line side of the relays, sized to provide control power for the local panel-mounted relays, bus system, control-voltage inputs, field-installed occupancy sensors, and photo sensors.

G. Operator Interface:

- 1. Integral alphanumeric keypad and digital display, and intuitive drop-down menus to assist in programming.
- 2. Log and display relay on-time.
- 3. Connect relays to one or more time and sequencing schemes.

2.3 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Class 2 Power Source: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Classes 2 and 3 Control Cables: Multiconductor cable with copper conductors not smaller than No. 22 AWG. Comply with requirements in Section 260523 "Control-Voltage Electrical Power Cables."
- C. Class 1 Control Cables: Multiconductor cable with copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 260523 "Control-Voltage Electrical Power Cables."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Receive, inspect, handle, and store panels in accordance with NECA 407.
- B. Examine panels before installation. Reject panels that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panels for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF WIRING

A. Wiring Methods:

1. Install cables in raceways
2. Conceal raceway and cables except in unfinished spaces.
3. Provide plenum-rated cable, where installed exposed or in open cable tray, within environmental airspaces, including plenum ceilings.
4. Comply with requirements for raceways specified in Section 260533.13 "Conduits for Electrical Systems."

B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

3.3 INSTALLATION OF PANELS

A. Install panels and accessories in accordance with NECA 407.

B. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

C. Mount top of trim 90 inch above finished floor unless otherwise indicated.

D. Mount panel cabinet plumb and rigid without distortion of box.

E. Install filler plates in unused spaces.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Create a directory to indicate loads served by each relay; incorporate Owner's final room designations. Obtain approval before installing. Use a PC or typewriter to create directory; handwritten directories are unacceptable.

C. Lighting Control Panel Nameplates: Label each panel with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with manufacturer's test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

- B. Lighting control panel will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports, including a certified report that identifies lighting control panels and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.6 SYSTEM STARTUP

- A. Perform startup service.
 - 1. Complete installation and startup checks in accordance with manufacturer's instructions.
 - 2. Confirm correct communications wiring, initiate communications between panels, and program the lighting control system in accordance with approved configuration schedules, time-of-day schedules, and input override assignments.

3.7 ADJUSTING

- A. 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.

3.8 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain the control unit and operator interface.

END OF SECTION 260943.23

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SECTION 262213

LOW-VOLTAGE DISTRIBUTION TRANSFORMERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Distribution, dry-type transformers with nominal primary and secondary rating of 600 V and less, with capacities up to 1500 kVA.

1.2 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.
 - a. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type and size of transformer.
 - b. Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer.

B. Shop Drawings:

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of field connections.
2. Equipment Room Layouts: Submit dimensioned drawings of all equipment rooms indicating spatial relationships to other proximate equipment. Ensure that all code required clearances are maintained.

C. Field Quality-Control Submittals:

1. Field quality-control reports.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Inspection: On receipt, inspect for and note shipping damage to packaging and transformer.

1. If manufacturer packaging is removed for inspection, and transformer will be stored after inspection, re-package transformer using original or new packaging materials that provide protection equivalent to manufacturer's packaging.

B. Storage: Store in warm, dry, and temperature-stable location in original shipping packaging.

C. Temporary Heating: Apply temporary heat in accordance with manufacturer's published instructions within enclosure of ventilated-type units, throughout periods during which

equipment is not energized and when transformer is not in space that is continuously under normal control of temperature and humidity.

- D. Handling: Follow manufacturer's instructions for lifting and transporting transformers.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ABB, Electrification Products Division (GE).
 - 2. Eaton.
 - 3. Siemens Industry, Inc., Energy Management Division.
 - 4. Square D; Schneider Electric USA.
- B. Source Limitations: Obtain each type of transformer from single source from single manufacturer.

2.2 GENERAL TRANSFORMER REQUIREMENTS

- A. Description: Factory-assembled and -tested, air-cooled units for 60 Hz service.
- B. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
- C. Transformers Rated 15 kVA and Larger:
 - 1. Comply with 10 CFR 431 (DOE 2016) efficiency levels.
 - 2. Marked as compliant with DOE 2016 efficiency levels by qualified electrical testing laboratory recognized by authorities having jurisdiction.
- D. Shipping Restraints: Paint or otherwise color-code bolts, wedges, blocks, and other restraints that are to be removed after installation and before energizing. Use fluorescent colors that are easily identifiable inside transformer enclosure.

2.3 DISTRIBUTION TRANSFORMERS

- A. Comply with NFPA 70, and list and label as complying with UL 1561.
- B. Cores: Electrical grade, non-aging silicon steel with high permeability and low hysteresis losses.
 - 1. One leg per phase.
- C. Coils: Continuous windings[without splices] except for taps.
 - 1. Coil Material: Aluminum or Copper (refer to Drawings).
 - 2. Internal Coil Connections: Brazed or pressure type.

- D. Encapsulation: Transformers smaller than 30 kVA must have core and coils completely resin encapsulated.
- E. Enclosure: Ventilated.
 - 1. Environmental Protection:
 - a. Indoor: UL 50E, Type 2.
 - b. Outdoor: UL 50E, Type 3R.
 - 2. Finish Color: ANSI 61 gray weather-resistant enamel.
- F. Taps for Transformers 3 kVA and Smaller: None.
- 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, Smaller Than 30 kVA: 180 deg C, UL-component-recognized insulation system with maximum of 115 deg C rise above 40 deg C ambient temperature.
- J. Insulation Class, 30 kVA and Larger: 220 deg C, UL-component-recognized insulation system with maximum of 115 deg C rise above 40 deg C ambient temperature.
- K. Grounding: Provide ground-bar kit or ground bar installed on inside of transformer enclosure.
- L. K-Factor Rating: Transformers indicated to be K-factor rated must comply with UL 1561 requirements for nonsinusoidal load current-handling capability to degree defined by designated K-factor.
 - 1. Unit may not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor, without exceeding indicated insulation class in 40 deg C maximum ambient and 24-hour average ambient of 30 deg C.
 - 2. Indicate value of K-factor on transformer nameplate.
- M. Electrostatic Shielding: Windings must have independent, single, full-width copper electrostatic shield arranged to minimize interwinding capacitance.
 - 1. Arrange coil leads and terminal strips to minimize capacitive coupling between input and output terminals.
 - 2. Include special terminal for grounding shield.
- N. Neutral: Rated 200 percent of full load current for K-factor-rated transformers.
- O. Wall Brackets: Manufacturer's standard brackets.
- P. Low-Sound-Level Requirements: Maximum sound levels when factory tested in accordance with IEEE C57.12.91, as follows:
 - 1. 9.00 kVA and Less: 40 dB(A-weighted).
 - 2. 9.01 to 30.00 kVA: 45 dB(A-weighted).
 - 3. 30.01 to 50.00 kVA: 45 dB(A-weighted) for K-factors of 1, 4, and 9.
 - 4. 50.01 to 150.00 kVA: 50 dB(A-weighted) for K-factors of 1, 4, and 9.

5. 150.01 to 300.00 kVA: 55 dB(A-weighted) for K-factors of 1, 4, and 9.

2.4 IDENTIFICATION

A. Nameplates:

1. Engraved, laminated-acrylic or melamine plastic signs for distribution transformers, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 260553 "Identification for Electrical Systems."

2.5 SOURCE QUALITY CONTROL

A. Testing Administrant: Engage qualified electrical testing agency to evaluate transformer.

B. Factory Tests and Inspections: Test and inspect assembled system, by, or under supervision of, qualified electrical testing laboratory recognized by authorities having jurisdiction, in accordance with IEEE C57.12.01 and IEEE C57.12.91 before delivering to site. Affix label with name and date of [manufacturer's][qualified electrical testing laboratory's] certification of system compliance on control units.

1. Resistance measurements of windings at rated voltage connections and at tap connections.
2. Ratio tests at rated voltage connections and at tap connections.
3. Phase relation and polarity tests at rated voltage connections.
4. No load losses, and excitation current and rated voltage at rated voltage connections.
5. Impedance and load losses at rated current and rated frequency at rated voltage connections.
6. Applied and induced tensile tests.
7. Regulation and efficiency at rated load and voltage.
8. Insulation-Resistance Tests:
 - a. Line-side to ground.
 - b. Load-side to ground.
 - c. Line-side to load-side.
9. Temperature tests.
10. Factory Sound-Level Tests: Conduct sound-level tests on equipment for this Project.

C. Nonconforming Work:

1. System equipment that does not pass tests and inspections will be considered defective.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for transformers.

- B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's published 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 Section 260526 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance must be 5 Ω at location of transformer.
- E. Environment: Enclosures must be rated for environment in which they are located. Covers for UL 50E, Type 4X enclosures may not cause accessibility problems.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install wall-mounted transformers level and plumb with wall brackets fabricated by transformer manufacturer or from design drawings signed and sealed by qualified structural professional engineer.
 - 1. Coordinate installation of wall-mounted and structure-hanging supports with actual transformer provided.
 - 2. Brace wall-mounted transformers as specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- B. Install transformers level and plumb on concrete base with vibration-dampening supports. Locate transformers away from corners and not parallel to adjacent wall surface.
- C. Construct concrete bases and anchor floor-mounted transformers in accordance with manufacturer's published instructions, seismic requirements applicable to Project, and requirements in Section 260529 "Hangers and Supports for Electrical Systems."
 - 1. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
- D. Secure transformer to concrete base in accordance with manufacturer's published instructions.
- E. Secure covers to enclosure and tighten bolts to manufacturer-recommended torques to reduce noise generation.
- F. Remove shipping bolts, blocking, and wedges.

3.3 CONNECTIONS

- A. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Tighten electrical connectors and terminals in accordance with manufacturer's published

torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

- D. Provide flexible connections at conduit and conductor terminations and supports to eliminate sound and vibration transmission to building structure.

3.4 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Small (Up to 167 kVA Single-Phase or 500 kVA Three-Phase) Dry-Type Transformer Field Tests:

a. Visual and Mechanical Inspection.

- 1) Inspect physical and mechanical condition.
- 2) Inspect anchorage, alignment, and grounding.
- 3) Verify that resilient mounts are free and that shipping brackets have been removed.
- 4) Verify that unit is clean.
- 5) Perform specific inspections and mechanical tests recommended by manufacturer.
- 6) Verify that as-left tap connections are as specified.
- 7) Verify presence of surge arresters and that their ratings are as specified.

b. Electrical Tests:

- 1) Measure resistance at windings, taps, and bolted connections.
- 2) Perform insulation-resistance tests winding-to-winding and windings-to-ground. Apply voltage in accordance with manufacturer's published data. In absence of manufacturer's published data, comply with NETA ATS, Table 100.5. Calculate polarization index: value of index may not be less than 1.0.
- 3) Perform turns-ratio tests at tap positions. Test results may not deviate by more than one-half percent from either adjacent coils or calculated ratio. If test fails, replace transformer.
- 4) Verify correct secondary voltage, phase-to-phase and phase-to-neutral, after energization and prior to loading.

- B. Test Labeling: On completion of satisfactory testing of units, attach dated and signed "Satisfactory Test" label to tested components.

3.5 ADJUSTING

- A. Record transformer secondary voltage at 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 5 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 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 262213

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SECTION 262413

SWITCHBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Switchboards.
2. Surge protection devices.
3. Disconnecting and overcurrent protective devices.
4. Instrumentation.
5. Accessory components and features.

B. Related Requirements

1. Section 260673 "Protective Device Study" for arc-flash analysis and arc-flash label requirements.

1.2 COORDINATION

- A. 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. 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.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Switchboards.
2. Overcurrent protective devices.
3. Surge protection devices.
4. Ground-fault protection devices.
5. Accessories.
6. Other components.
7. 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. Equipment Room Layouts: Submit dimensioned drawings of all equipment rooms indicating spatial relationships to other proximate equipment. Ensure that all code required clearances are maintained.
3. Detail enclosure types for types other than UL 50E, Type 1.
4. Detail bus configuration, current, and voltage ratings.
5. Detail short-circuit current rating of switchboards and overcurrent protective devices.

1.4 INFORMATIONAL SUBMITTALS

- A. Manufacturers' Published Instructions: Record copy of official installation[and testing] instructions issued to Installer by manufacturer for the following:
 1. Handling, storing, and providing temporary heat.
 2. Mounting accessories and anchoring devices.
 3. Testing and adjusting overcurrent protective devices.

1.5 CLOSEOUT SUBMITTALS

- A. Warranty documentation.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Special Tools: Furnish to Owner proprietary equipment, keys, and software required to operate, maintain, repair, adjust, or implement future changes to switchboards, that are packaged with protective covering for storage on-site and identified with labels describing contents.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.
- B. Handle and prepare switchboards for installation in accordance with NECA 400 and NEMA PB 2.1.

1.8 WARRANTY

- A. Warranty: Manufacturer warrants that switchboard performs in accordance with specified requirements and agrees to provide repair or replacement of components that fail to perform as specified within extended-warranty period.
 1. -Warranty Period: Three years from date of Substantial Completion; full coverage for labor, materials, and equipment.

PART 2 - PRODUCTS

2.1 SWITCHBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ABB, Electrification Business (GE).
 2. Eaton.
 3. Siemens Industry, Inc., Energy Management Division.
 4. Square D; Schneider Electric USA.
- 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 in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
- E. Comply with NEMA PB 2.
- F. Comply with NFPA 70.
- G. Comply with UL 891.
- H. Front-Connected, Front-Accessible Switchboards:
1. Main Devices: Fixed, individually mounted.
 2. Branch Devices: Panel mounted.
 3. Sections front and rear aligned.
- I. Nominal System Voltage: 480Y/277 V or 208Y/120 V (refer to Drawings).
- J. Main-Bus Continuous: As shown on Drawings.
- K. Indoor Enclosures: Steel, UL 50E, Type 1.
- L. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over rust-inhibiting primer on treated metal surface.
- M. Outdoor Enclosures: Type 3R.
1. Finish: Factory-applied finish in manufacturer's standard color; undersurfaces treated with corrosion-resistant undercoating.
- N. Barriers: Between adjacent switchboard sections.
- O. Insulation and isolation for main bus of main section and main and vertical buses of feeder sections.
- P. Service Entrance Rating: Switchboards intended for use as service entrance equipment may contain from one to six service disconnecting means with overcurrent protection, neutral bus with disconnecting link, grounding electrode conductor terminal, and main bonding jumper.

- Q. Utility Metering Compartment: Barrier compartment and section complying with utility company's requirements; hinged sealable door; buses provisioned for mounting utility company's current transformers and potential transformers or potential taps as required by utility company. If separate vertical section is required for utility metering, match and align with basic switchboard. Provide service entrance label and necessary applicable service entrance features.
- R. Customer Metering Compartment: Separate customer metering compartment for indicated metering, and current transformers for each meter. Current transformer secondary wiring must be terminated on shorting-type terminal blocks.
- S. Buses and Connections: Three phase, four wire unless otherwise indicated.
 - 1. Provide phase bus arrangement A, B, C from front to back, top to bottom, and left to right when viewed from front of switchboard.
 - 2. Phase- and Neutral-Bus Material:
 - a. Hard-drawn copper of 98 percent conductivity, silver-plated, or
 - b. Tin-plated, high-strength, electrical-grade aluminum alloy with tin-plated aluminum circuit-breaker line connections.
 - 3. Copper feeder circuit-breaker line connections.
 - 4. Load Terminals: Insulated, rigidly braced, runback bus extensions, of same material as through buses, equipped with compression connectors for outgoing circuit conductors. Provide load terminals for future circuit-breaker positions at full-ampere rating of circuit-breaker position.
 - 5. Ground Bus: 1/4 by 2 inch hard-drawn copper of 98 percent conductivity, equipped with compression connectors for feeder and branch-circuit ground conductors.
 - 6. 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.
 - 7. Disconnect Links:
 - a. Isolate neutral bus from incoming neutral conductors.
 - b. Bond neutral bus to equipment-ground bus for switchboards utilized as service equipment or separately derived systems.
 - 8. Neutral Buses: 100 percent of ampacity of phase buses unless otherwise indicated, equipped with compression connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.
- T. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.
- U. Bus-Bar Insulation: Factory-applied, flame-retardant, tape wrapping of individual bus bars or flame-retardant, spray-applied insulation. Minimum insulation temperature rating of 105 deg C.

2.2 SURGE PROTECTION DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ABB, Electrification Business (GE).

2. Eaton.
 3. Siemens Industry, Inc., Energy Management Division.
 4. Square D; Schneider Electric USA.
- B. SPDs: Listed and labeled in accordance with UL 1449, Type 1.
- C. Features and Accessories:
1. Integral disconnect switch.
 2. Form-C contacts rated at 5 A and 250 V(ac), one normally open and one normally closed, for remote monitoring of protection status. Contacts must reverse on failure of surge diversion module or on opening of current-limiting device. Coordinate with building power monitoring and control system.
 3. Surge counter.
- D. Peak Surge Current Rating: Minimum single-pulse surge current withstand rating per phase may not be less than 250 kA. Peak surge current rating must be arithmetic sum of ratings of individual MOVs in each 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 may 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 may not exceed the following:
1. Line to Neutral: 700 V.
 2. Line to Ground: 1000 V.
 3. Line to Line: 1000 V.
- G. SCCR: Equal or exceed 200 kA.
- H. Nominal Rating: 20 kA.

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-replaceable electronic trip; and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long and short time adjustments.

- d. Ground-fault pickup level, time delay, and I^2t response.
- 4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
- 5. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30 mA trip).

2.4 INSTRUMENTATION

- A. Instrument Transformers: NEMA EI 21.1, and the following:
 - 1. Potential Transformers: NEMA EI 21.1; 120 V, 60 Hz, single secondary; disconnecting type with integral fuse mountings. Burden and accuracy must be consistent with connected metering and relay devices.
 - 2. Current Transformers: NEMA EI 21.1; 5 A, 60 Hz, secondary; bar or window type; single secondary winding and secondary shorting device. Burden and accuracy must be consistent with connected metering and relay devices.
 - 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 and with the following features:
 - 1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:
 - a. Phase Currents, Each Phase: Plus or minus 0.5 percent.
 - b. Phase-to-Phase Voltages, Three Phase: Plus or minus 0.5 percent.
 - c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 0.5 percent.
 - d. Megawatts: Plus or minus 1 percent.
 - e. Megavars: Plus or minus 1 percent.
 - f. Power Factor: Plus or minus 1 percent.
 - g. Frequency: Plus or minus 0.1 percent.
 - h. Accumulated Energy, Megawatt Hours: Plus or minus 1 percent; accumulated values unaffected by power outages up to 72 hours.
 - i. Megawatt Demand: Plus or minus 1 percent; demand interval programmable from five to 60 minutes.
 - j. Contact devices to operate remote impulse-totalizing demand meter.
 - 2. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.

2.5 ACCESSORY COMPONENTS AND FEATURES

- A. Mounting Accessories: For anchors, mounting channels, bolts, washers, and other mounting accessories, comply with requirements in Section 260548.16 "Seismic Controls for Electrical Systems" or manufacturer's instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Receive, inspect, handle, and store switchboards in accordance with NECA 400 and NEMA PB 2.1.
 - 1. Lift or move panelboards with spreader bars and manufacturer-supplied lifting straps following manufacturer's published instructions.
 - 2. Use rollers, slings, or other manufacturer-approved methods if lifting straps are not furnished.
 - 3. Protect from moisture, dust, dirt, and debris during storage and installation.
 - 4. Install temporary heating during storage in accordance with manufacturer's published instructions.
- 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 or that affect performance of equipment.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's published instructions.
- B. Reference Standards:
 - 1. Switchboards and Accessories: Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NECA 400 and NEMA PB 2.1.
 - 2. Consult Architect for resolution of conflicting requirements.
- C. Special Techniques:
 - 1. Equipment Mounting: Install switchboards on concrete base, 4 inch nominal thickness. Comply with requirements for concrete base specified in Section 260529 "Hangers and Supports for Electrical Systems."
 - a. Install conduits entering underneath switchboard, entering under vertical section where conductors will terminate. Install with couplings flush with concrete base. Extend 2 inch above concrete base after switchboard is anchored in place.
 - b. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18 inch centers around full perimeter of concrete base.
 - c. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - d. Place and secure anchorage devices. Use setting drawings, templates, diagrams, published instructions, and directions furnished with items to be embedded.
 - e. Install anchor bolts to elevations required for proper attachment to switchboards.

- f. Anchor switchboard to building structure at top of switchboard if required or recommended by manufacturer.
- 2. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, straps and brackets, and temporary blocking of moving parts from switchboard units and components.
- 3. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- 4. Operating Instructions: Frame and mount 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.
- 5. Install filler plates in unused spaces of panel-mounted sections.
- 6. Install overcurrent protective devices, surge protection devices, and instrumentation.
 - a. Set field-adjustable switches and circuit-breaker trip ranges.

3.3 CONNECTIONS

- A. Bond conduits entering underneath switchboard to equipment ground bus with bonding conductor sized in accordance with NFPA 70.
- B. Support and secure conductors within switchboard in accordance with NFPA 70.
- C. Extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.

3.4 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Switchboard Nameplates: Label each switchboard compartment with nameplate complying with requirements for identification specified in Section 260553 "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 nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems." Label each device with engraved laminated-plastic nameplate.

3.5 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Acceptance Testing:
 - a. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit. Open control and metering circuits within switchboard, and remove neutral connection to surge protection and other

- electronic devices prior to insulation test. Reconnect after test.
 - b. Test continuity of each circuit.
- 2. Test ground-fault protection of equipment for service equipment in accordance with NFPA 70.
- 3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- 4. Correct malfunctioning units on-site where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- 5. Perform the following infrared scan tests and inspections, and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform infrared scan of each switchboard.
 - b. Follow-up Infrared Scanning: Perform additional follow-up infrared scan of each switchboard 11 months after date of Substantial Completion.
 - c. Instruments and Equipment:
 - 1) Use infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
- 6. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

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 specified in Section 260673 "Protective Device Study."

3.7 PROTECTION

- A. Temporary Heating: Apply temporary heat, to maintain temperature in accordance with manufacturer's published instructions, until switchboard is ready to be energized and placed into service.

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SECTION 262416

PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Power panelboards.
2. Lighting and appliance branch-circuit panelboards.
3. Disconnecting and overcurrent protective devices.

1.2 DEFINITIONS

- A. GFEP: Ground-fault equipment protection.
- B. MCCB: Molded-case circuit breaker.
- C. VPR: Voltage protection rating.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Power panelboards.
2. Lighting and appliance branch-circuit panelboards.
3. Disconnecting and overcurrent protective devices.
4. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
5. 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.
2. Equipment Room Layouts: Submit dimensioned drawings of all equipment rooms indicating spatial relationships to other proximate equipment. Ensure that all code required clearances are maintained.
3. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
4. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
5. Detail bus configuration, current, and voltage ratings.
6. Short-circuit current rating of panelboards and overcurrent protective devices.

1.4 CLOSEOUT SUBMITTALS

- A. Warranty documentation.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Spare Parts: Furnish to Owner spare parts, for repairing panelboards, that are packaged with protective covering for storage on-site and identified with labels describing contents. Include the following:

- 1. Keys: Two spares for each type of panelboard cabinet lock.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Handle and prepare panelboards for installation in accordance with NECA 407 and NEMA PB 1.

1.7 WARRANTY

- A. Warranty: Manufacturer warrants that panelboards perform in accordance with specified requirements and agrees to provide repair or replacement of components or products that fail to perform as specified within extended-warranty period.

- 1. Warranty Period: Three years from date of Substantial Completion; full coverage for labor, materials, and equipment.

PART 2 - PRODUCTS

2.1 PANELBOARDS AND LOAD CENTERS COMMON REQUIREMENTS

- A. Fabricate and test panelboards in accordance with IEEE 344 to withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems."
- B. Comply with NEMA PB 1.
- C. Comply with NFPA 70.
- D. Enclosures: Flush or Surface-mounted, dead-front cabinets.
 - 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: UL 50E, Type 1.
 - b. Outdoor Locations: UL 50E, Type 3R.
 - 2. Height: 7 ft maximum.
 - 3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims must cover live parts and may have no exposed hardware.
 - 4. Hinged Front Cover: Entire front trim hinged to box and with standard door within

hinged trim cover. Trims must cover live parts and may have no exposed hardware.

5. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
6. Finishes:
 - a. Panels and Trim: galvanized 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: Same finish as panels and trim.

E. Incoming Mains:

1. Location: Top or Bottom.
2. Main Breaker: Main lug interiors up to 400 A must be field convertible to main breaker.

F. Phase, Neutral, and Ground Buses:

1. Material: Tin-plated aluminum or Hard-drawn copper, 98 percent conductivity, refer to Drawings.
 - a. Plating must run entire length of bus.
 - b. Bus must be fully rated for entire length.
2. Interiors must be factory assembled into unit. Replacing switching and protective devices may not disturb adjacent units or require removing main bus connectors.
3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
4. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure.

G. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Tin-plated aluminum or Hard-drawn copper, 98 percent conductivity.
2. Terminations must allow use of 75 deg C rated conductors without derating.
3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
4. Main and Neutral Lugs: Compression type, with lug on neutral bar for each pole in panelboard.
5. Ground Lugs and Bus-Configured Terminators: Compression type, with lug on bar for each pole in panelboard.
6. Feed-Through Lugs: Compression type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
7. Subfeed (Double) Lugs: Compression type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

H. Future Devices: Panelboards or load centers must have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

1. Percentage of Future Space Capacity: 25 percent.

I. Panelboard Short-Circuit Current Rating:

1. Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for 100 percent interrupting capacity.
 - a. Panelboards and overcurrent protective devices rated 240 V or less must have short-circuit ratings as shown on Drawings, but not less than 10 000 A(rms) symmetrical.
 - b. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V must have short-circuit ratings as shown on Drawings, but not less than 14 000 A(rms) symmetrical.
- J. Surge Suppression: Factory installed as integral part of indicated panelboards, complying with UL 1449 SPD Type 1.

2.2 POWER PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. ABB, Electrification Business (GE).
 2. Eaton.
 3. Siemens Industry, Inc., Energy Management Division.
 4. Square D; Schneider Electric USA.
- B. Listing Criteria: NEMA PB 1, distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
 1. For doors more than 36 inch high, provide two latches, keyed alike.
- D. Mains: Circuit breaker or Lugs only.
- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
- F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. ABB, Electrification Business (GE).
 2. Eaton.
 3. Siemens Industry, Inc., Energy Management Division.
 4. Square D; Schneider Electric USA.
- B. Listing Criteria: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: Circuit breaker or lugs only.

- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Doors: Door-in-door construction with concealed hinges; secured with multipoint latch with tumbler lock; keyed alike. Outer door must permit full access to panel interior. Inner door must permit access to breaker operating handles and labeling, but current carrying terminals and bus must remain concealed.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ABB, Electrification Business (GE).
 - 2. Eaton.
 - 3. Siemens Industry, Inc., Energy Management Division.
 - 4. Square D; Schneider Electric USA.
- B. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers:
 - a. Inverse time-current element for low-level overloads.
 - b. Instantaneous magnetic trip element for short circuits.
 - c. 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:
 - a. RMS sensing.
 - b. Field-replaceable rating plug or electronic trip.
 - c. Digital display of settings, trip targets, and indicated metering displays.
 - d. Multi-button keypad to access programmable functions and monitored data.
 - e. Integral test jack for connection to portable test set or laptop computer.
 - f. Field-Adjustable Settings:
 - 1) Instantaneous trip.
 - 2) Long- and short-time pickup levels.
 - 3) Long and short time adjustments.
 - 4) Ground-fault pickup level, time delay, and I squared T response.
 - 4. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6 mA trip).
 - 5. GFEP Circuit Breakers: Class B ground-fault protection (30 mA trip).
 - 6. Subfeed Circuit Breakers: Vertically mounted.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.
- B. Receive, inspect, handle, and store panelboards in accordance with NECA 407 and NEMA PB 1.1.
- C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.
- D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's published instructions.
- B. Reference Standards:
 - 1. Panelboards: Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NECA 407 and NEMA PB 1.1.
 - 2. Consult Engineer for resolution of conflicting requirements.
- C. Special Techniques:
 - 1. Equipment Mounting:
 - a. Attach panelboard to vertical finished or structural surface behind panelboard.
 - b. Comply with requirements for seismic control devices specified in Section 260548.16 "Seismic Controls for Electrical Systems."
 - 2. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
 - 3. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
 - 4. Mount top of trim between 60 inches and 90 inches above finished floor unless otherwise indicated.
 - 5. Mount panelboard cabinet plumb and rigid without distortion of box.
 - 6. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
 - 7. Install overcurrent protective devices and controllers not already factory installed.
 - a. Set field-adjustable, circuit-breaker trip ranges.
 - b. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver in accordance with manufacturer's published instructions.

8. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.
9. Install filler plates in unused spaces.
10. Stub four 1 inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in future. Stub four 1 inch empty conduits into raised floor space or below slab not on grade.
11. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."
- B. Panelboard Nameplates: Label each panelboard with nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- C. Device Nameplates: Label each branch circuit device in power panelboards with nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- D. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.
- E. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles must be located on interior of panelboard door.
- F. Breaker Labels: Faceplate must list current rating, UL and IEC certification standards, and AIC rating.
- G. Circuit Directory:
 1. Provide computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.
 - a. Circuit directory must identify specific purpose with detail sufficient to distinguish it from other circuits.

3.4 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 1. For normal power and UPS panelboards feeding Simulator Equipment, perform the following infrared scan tests and inspections and prepare reports:
 - a. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Instruments and Equipment:

- 1) Use infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

B. Nonconforming Work:

1. Panelboards will be considered defective if they do not pass tests and inspections.
2. Remove and replace defective units and retest.

C. Collect, assemble, and submit test and inspection reports, including certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 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 as specified in Section 260673 "Protective Device Study."

END OF SECTION 262416

SECTION 262653

ELECTRIC VEHICLE SERVICE EQUIPMENT - LEVEL 2

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 EV charging equipment that provides Level 2 EV charging.

1.3 DEFINITIONS

- A. EV: Electric vehicle.
- B. EV Cable: The off-board cable containing the conductor(s) to connect the EV power controller to the EV that provides both power and communications during energy transfer.
- C. EV Charger or EV Charging Equipment: See "EVSE."
- D. EV Connector: A conductive device that, when electrically coupled to an EV inlet, establishes an electrical connection to the EV for the purpose of power transfer and information exchange. This device is part of the EV coupler.
- E. EV Coupler: A mating EV inlet and connector set.
- F. EV Inlet: The device in the vehicle into which the EV connector is inserted, and a conductive connection is made for the transfer of power and communication. This device is part of the EV coupler.
- G. EVSE: Electric Vehicle Supply Equipment. It includes the EV charging equipment and conductors, including the ungrounded, grounded, and equipment grounding conductors and EV cables, attachment plugs, and all other fittings, devices, power outlets, or apparatus installed specifically for transferring energy between the premise wiring and the EV.

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 EV charging equipment.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For EV charging equipment to include in operation and maintenance manuals.
- B. Software and Firmware Operational Documentation:
 - 1. Software operating manuals.
 - 2. Program Software Backup: On USB, CD, Cloud, or approved media, complete with configuration files.
 - 3. Device address list.
 - 4. Printout of software application and graphic screens.

1.7 FIELD CONDITIONS

- A. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - 1. Ambient Temperature: Not exceeding minus 22 to plus 122 deg F.
 - 2. Altitude: Not exceeding 4500 feet.

1.8 WARRANTY

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components of EV charging units that fail(s) in materials or workmanship within specified warranty period.
 - 1. Warranty Period: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURER/MODEL

- A. Manufacturers: provide products by one of the following:
 - 1. Wallbox US (see Drawings for model number)

2.2 GENERAL REQUIREMENTS

- A. EVSE must have drivers assistance that includes toll free number printed on station.
- B. EVSE must have the ability to notify driver when charging is complete or if a charging session has been disrupted.
- C. EVSE must have ability to limit access to the station.

- D. EVSE must have the ability to collect revenue from the driver but shall be disabled.
- E. EVSE must have flexible pricing options, including hourly, by kwh, by session, and vary the price by time of day or length of session.
- F. EVSE must be able to provide free charging to select vehicles/drivers.
- G. EVSE real-time status and availability must be available to drivers online via mobile app and/or website.
- H. EVSE real-time status and availability must be available to station owners via secure website.
- I. The following information for each charging event (session) will be collected and available via secure web interface, and available for download/export to Excel/CSV:
 - 1. Time Stamp (time zone local to EVSE)
 - 2. Unique ID for Charging Event
 - 3. Unique ID for EVSE
 - 4. EVSE Name
 - 5. EVSE Address
 - 6. Port Number (if dual port EVSE)
 - 7. Port Type (L1, L2, DC)
 - 8. Charging Event Duration (connect time)
 - 9. Active Charging Time
 - 10. Energy (kWh)
 - 11. Session fee (if any)
 - 12. Unique ID for Driver
- J. Report showing number of sessions by time, viewable by sessions per day, per week, or per month and exportable to Excel/CSV.
- K. Report showing total energy (kWh), viewable by energy per day, per week, or per month and exportable to Excel/CSV.
- L. Report showing number of unique drivers by time, viewable per day, per week, or per month and exportable to Excel/CSV.
- M. Report showing station utilization (hours per day), configurable by hours of the day (e.g. 8am to 5pm), weekday vs weekend (or both), and by port type (L1, L2, DC).
- N. Report showing revenue over time, viewable by day, by week, or by month and exportable to Excel/CSV.
- O. Driver Support: 24/7 direct toll free technical support telephone number. Drivers support must be able to activate stations and process payments over the phone for drivers that are unable to do so at the station
- P. Technical Support: Provide customer support service (telephone and e-mail) to assist in EVSE operations and provide general assistance with policies and best practices.
- Q. EVSE must provide a standards-based interface for energy management.
- R. EVSE must have ability to set (by port) allowed load based on percentage of current load or set a maximum load (kW).

- S. EVSE must have ability to set an aggregate maximum load for a group of stations. The stations will self-manage to remain below the configured allowance with no additional physical hardware required.
- T. Report on Rolling Average Power (kW) and Peak Power (kW) in 15 minute intervals with ability to export to Excel/CSV, and report on Energy (kWh) by EVSE or by group of EVSE with ability to export to Excel/CSV.
- U. Refer to paragraphs 3.3 START UP SERVICE, 3.7 SERVICE PROVIDER PLAN, and 3.8 SOFTWARE SERVICE AGREEMENT of this section for additional requirements.

2.3 EV CHARGING EQUIPMENT 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 use.
- B. ADA compliant.
- C. Enclosures:
 - 1. Rated for environmental conditions at installed location.
 - a. Indoor/outdoor rated.
- D. EV Cable and Connectors:
 - 1. SAE J1772 connector.
 - 2. Double connectors with locking holster.
 - 3. 23-foot cable with cable management system.
 - 4. Field-replaceable connector and cable assembly.
- E. Status Indicators
 - 1. LEDs to indicate power, charging, charging complete, system status, faults, and service.
- F. Display Screen:
 - 1. Daylight viewable, UV-protected display with human-machine interface capability.
 - 2. Displays power, charging, charging complete, remote control, system status, faults, and service.
- G. Networking:
 - 1. WAN Communications: Cellular 3G GSM, 3G CDMA.
 - 2. Capable of remote configuration and reporting.
- H. Payment System:
 - 1. NFC, Contactless credit card, and credit card reader.
 - 2. PCI compliant.
 - 3. Capable of remote control and authorization.
- I. Charging Network: Compatible with the Blink (or approved equal) EV charging network.

1. Multiple units shall have one unit designated as a master unit that is configured as a gateway unit between the EV charging equipment and the charging network.

2.4 PERFORMANCE REQUIREMENTS

- A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
- B. Surge Withstand: 6 kV at 3000 A.
- C. Integral GFCI.
- D. Auto-GFCI fault retry.
- E. Input Power: As shown in Drawings.
- F. EV Charging Levels: As shown in Drawings.

2.5 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by utilizing cushioning materials or foam or by applying a strippable, temporary protective covering before shipping.

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 roughing-in for EV charging equipment electrical conduit to verify actual locations of conduit connections before equipment installation.
- C. Examine floors and pavement for suitable conditions where EV charging equipment will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with NECA 1 and NECA 413.
- B. Concrete Base Mounting:
 1. Install EV charging equipment on 6-inch nominal-thickness concrete base. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."
 - a. 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.
 - b. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - c. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - d. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - e. Secure EV charging equipment to concrete base according to manufacturer's written instructions.
- 2. Install EV charging equipment on 12-inch nominal-diameter and 48-inch- deep concrete base. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."
 - a. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - b. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - c. Secure EV charging equipment to concrete base according to manufacturer's written instructions.
- C. Pole Mounting:
 - 1. Allow a minimum of 24 inches of clearance around EV charging equipment.
 - 2. EV charging equipment receptacles or holders shall be not less than 24 inches and not more than 4 feet above finished grade.
 - 3. Mount EV charging equipment plumb and rigid without distortion of enclosure.
 - 4. Secure EV charging equipment according to manufacturer's written instructions.
- D. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- E. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
- F. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking from enclosures and components.
- G. Secure covers to enclosure.
- 3.3 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-486B.
- 3.4 IDENTIFICATION
 - A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections with the assistance of a factory-authorized service representative.
- B. Tests and Inspections:
 - 1. For each unit of EV charging equipment, perform the following tests and inspections:
 - a. Unit self-test.
 - b. Operation test with EV.
- C. EV charging equipment will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.6 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
- B. Complete installation and startup checks according to manufacturer's written instructions.

3.7 SERVICE PROVIDER PLAN

- A. 1 year.

3.8 SOFTWARE SERVICE AGREEMENT

- A. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within one year from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.
 - 1. Upgrade Notice: At least 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

3.9 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain EV charging equipment.

END OF SECTION 262653.11

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SECTION 262713
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 equipment and data acquisition server (DAS) for electricity metering. The system shall comply with all IECC 2021 C405.12 requirements.
- B. The metering system and equipment shall have the capability provide at least hourly data that is fully integrated into the data acquisition system and graphical energy report.
- C. The data acquisition system shall have the capability to store the data from the meters for a minimum of 36 months. The data acquisition system shall have the capability to store real-time energy consumption data and provide hourly, daily, monthly and yearly logged data for each end-use category.
- D. Provide metering server, enclosures, nodes, meters, CTs, control cables, data and power cables as required for a complete system.
- E. The system shall be capable of metering different load categories as defined in IECC 2021 Table C405.12.2.
- F. The system shall include a reporting mechanism that has the capability to graphically provide the energy consumption for each end-use category required by IECC 2021 Table C405.12.2 at least every hour, day, month and year for the previous 36 months.

1.3 DEFINITIONS

- A. BACnet: Building automation and control networks.
- B. BAS: Building automation system.
- C. IP: Internet protocol.
- D. KY Pulse: Term used by the metering industry to describe a method of measuring consumption of electricity that is based on a relay opening and closing in response to the rotation of the disk in the meter.
- E. PC: Personal computer.

1.4 ACTION SUBMITTALS

- A. Product Data:
 - 1. For each type of meter.
 - 2. For metering infrastructure components.
 - 3. For metering software.
- B. Shop Drawings: For electricity-metering equipment.
 - 1. Include elevation views of front panels of control and indicating devices and control stations.
 - 2. Include diagrams for power, signal, and control wiring.
 - 3. Wire Termination Diagrams and Schedules: Include diagrams for power, signal, and control wiring. Identify terminals and wiring designations and color-codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features. Differentiate between manufacturer-installed and field-installed wiring.
 - 4. Show interconnections between components specified in this Section and
 - 5. devices furnished with power distribution system components. Indicate data communication paths and identify networks, data buses, data gateways, concentrators, and other devices used. Describe characteristics of network and other data communication lines.
 - 6. List network protocols and provide statements from manufacturers that input and output devices comply with interoperability requirements of the protocol.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. 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.
 - 5. Warranty documentation.

1.7 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. WARRANTY: Installer warrants that fabricated and installed metering equipment performs in accordance with specified requirements and agrees to repair or replace components or products that fail to perform as specified within extended-warranty period of three (3) years.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Receive, store, and handle modular meter center according to NECA 400.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
- B. Comply with UL 916.

2.2 METERS AND SOFTWARE

- A. Subject to compliance with requirements, provide power meters and software by one of the following:

- 1. Square D PM meter series and PME energy supply management software
- 2. Siemens PAC3220 or SEM3 meters and WinPM energy supply management software
- 3. Shark Meter Series and EnergyPQA/HMI Energy management software

All substitutions must be submitted in writing for prior approval at least 14 days prior to the last addendum. Proposed substitute products must be documented with a line-by-line compliance with the Code and basis of design products, product data sheets, wiring diagrams, etc.

- B. General Requirements for Meters:

- 1. Comply with UL 1244 and IECC 2021 C405.12 requirements.
- 2. Meters used for billing shall have an accuracy of 0.5 percent of reading, complying with requirements in NEMA ANSI C12.20 and NEMA ANSI C12.20.
- 3. Comply with BACnet protocol. If BACnet is not a native protocol, provide required hardware, conduits, wiring, and power as required to convert the protocol to BACnet.
- 4. Modular Meter Center: NEMA 250, Type 1 minimum, with hasps for padlocking or sealing. Size meter center to accommodate the number of meters indicated on the electrical drawings.
- 5. Identification: Comply with requirements in Section 260001 "Electrical General Provision."
- 6. Memory Backup: Self-contained to maintain memory throughout power outages of 72 hours, minimum.
- 7. Sensors: Current-sensing type, with current or voltage output, selected for optimum range and accuracy for meters indicated for this application.

- a. Type: Split core.

- 8. Building Automation System (BAS) Interface: One digital KY pulse to a user-definable increment of energy measurement. Match signal to BAS input and arrange to convey the instantaneous, integrated, demand level measured by meter to provide data for processing and possible programmed demand control action by destination system.

- C. 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.

- D. kWh Meter: Electronic single-phase and three-phase meters, measuring electricity use.

1. Voltage and Phase Configuration: Meter must be designed for use on circuits with voltage rating and phase configuration indicated for its application.
 2. Display:
 - a. LCD with characters not less than 0.25 inch (6 mm) high, indicating accumulative kWh and current kilowatt load. Retain accumulated kWh in nonvolatile memory, until reset.
- E. The meter shall be capable of metering and monitoring the following values:
1. Real-time readings
 - a. Current (per phase, N, G, 3 phase)
 - b. Voltage, per phase (L-L, L-N), and 3 phase average
 - c. Apparent RMS Current
 - d. Real Power (per phase, 3 phase)
 - e. Reactive Power (per phase, 3 phase)
 - f. Apparent Power (per phase, 3 phase)
 - g. Power Factor (per phase, 3 phase)
 - h. Frequency
 - i. THD (current and voltage)
 - j. K-factor (per phase)
 2. Demand Readings:
 - a. Demand Current (per phase present, peak)
 - b. Average Demand Current (per phase present, peak)
 - c. Peak Demand Current (per phase)
 - d. Average Power Factor (3 phase total)
 - e. Demand Real Power (3 phase total)
 - f. Average Demand Peak Power (3 phase total)
 - g. Predicted Demand Real Power
 - h. Peak Demand Real Power
 - i. Demand Apparent Power (3 phase total)
 3. Energy Readings:
 - a. Accumulated Energy, Real
 - b. Accumulated Energy, Reactive
 4. Power Analysis Values:
 - a. Crest Factor (per phase)
 - b. K-Factor Demand (per phase)
 - c. Displacement Power Factor (per phase, 3 phase)
 - d. Fundamental Voltages (per phase)
 - e. Fundamental Currents (per phase)
 - f. Fundamental Real Power (per phase)
 - g. Harmonic Power
 - h. Unbalance (current and voltage)
 5. Phase Rotation
- F. Data Transmission Cable: Transmit KY pulse data over Class 1 control-circuit conductors in raceway. Provide control-voltage power cables as recommended by the manufacturer.

- G. Software: PC-based product recommended by meter manufacturer, complying with IEC C2021 C405.12 requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with equipment installation requirements in NECA 1.
- B. Install modular meter center according to NECA 400 installation requirements.
- C. Meters shall be configured to automatically communicate energy consumption data to the data acquisition system.
- D. Install energy monitoring software on at least 10 Owner Provided PCs (coordinate with Owner).

3.2 IDENTIFICATION

- A. Comply with requirements for identification specified in Section 260001 "Electrical General Provisions."
 - 1. Equipment Identification Labels: Adhesive film labels with clear protective overlay for meters within modular meter center.

3.3 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. Tests and Inspections:
 - 1. Connect a load of known kilowatt rating, 1.5 kW minimum, to a circuit supplied by metered feeder.
 - 2. Turn off circuits supplied by metered feeder and secure them in off condition.
 - 3. Run test load continuously for eight hours minimum, or longer, to obtain a measurable meter indication. Use test-load placement and setting that ensures continuous, safe operation.
 - 4. Check and record meter reading at end of test period and compare with actual electricity used, based on test-load rating, duration of test, and sample measurements of supply voltage at test-load connection. Record test results.
- C. Electricity metering will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.4 BUILDING AUTOMATION SYSTEM CONNECTIONS

- A. Connect unit communication data link used for remote monitoring of unit to termination points within unit control panel.
 - 1. Wire, cable, conduit, and communication interface to comply with the requirements of Building Automation System Specifications.
- B. BAS Monitoring and Controls.
 - 1. At the minimum, BAS shall monitor the following points (if available in the specified meter):
 - a. Currents and voltages.
 - b. Power (apparent, real, and reactive).
 - c. Power factor; Frequency.
 - d. THD (voltage and current).
 - e. K-factor.
 - f. Misc demand readings (demand current, power, etc.).
 - g. Energy readings (accumulated real and reactive energy).
 - h. Power analysis values (crest factor, K-factor, harmonics...).

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain electricity metering system.
 - 1. Train Owner's maintenance personnel on procedures and schedules for troubleshooting, servicing, and maintaining equipment.
 - 2. Schedule training with Owner, through Architect, with at least seven days' advance notice

3.6 MAINTENANCE

- A. Software and Firmware Service Agreement:
 - 1. Technical Support: Beginning at Substantial Completion, verify that software and firmware service agreement includes software and firmware support for three years.
 - 2. Upgrade Service: At Substantial Completion, update software and firmware to latest version. Install and program software and firmware upgrades that become available within three years from date of Substantial Completion.
 - a. Upgrade Notice: No fewer than 30 days to allow Owner to schedule and access the system.
 - 3. Upgrade Reports: Prepare a report after each update, documenting upgrades installed.

END OF SECTION 262713

SECTION 262726

WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. General-use switches.
2. General-grade duplex straight-blade receptacles.
3. Locking receptacles.
4. Connectors, cords, and plugs.

B. Related Requirements:

1. Section 260923 "Lighting Control Devices" for occupancy sensors, timers, control-voltage switches, and control-voltage dimmers.
2. Section 260943.23 "Relay-Based Lighting Controls" for network lighting control relay devices.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 GENERAL-USE SWITCHES

A. Toggle Switch :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
- b. Leviton Manufacturing Co., Inc.
- c. Pass & Seymour; Legrand North America, LLC.
- d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.

2. Regulatory Requirements:

Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

3. General Characteristics:

- a. Reference Standards: UL CCN WMUZ and UL 20.

4. Options:
 - a. Device Color: White or Gray (final color to be selected by Architect).
5. Accessories:
 - a. Cover Plate: 0.060 inch thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
 - b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

2.2 GENERAL-GRADE DUPLEX STRAIGHT-BLADE RECEPTACLES

A. Duplex Straight-Blade Receptacle Insert drawing designation:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
 - b. Leviton Manufacturing Co., Inc.
 - c. Pass & Seymour; Legrand North America, LLC.
 - d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
2. General Characteristics:
 - a. Reference Standards: UL CCN RTRT and UL 498.
3. Options:
 - a. Device Color: White or Gray (final color to be selected by Architect) .
4. Accessories:
 - a. Cover Plate: 0.060 inch thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
 - b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

2.3 LOCKING RECEPTACLES

A. NEMA, 125 V, Locking Receptacle :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
 - b. Leviton Manufacturing Co., Inc.
 - c. Pass & Seymour; Legrand North America, LLC.
 - d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
2. Options:
 - a. Device Color: Black with yellow voltage indication on face.
 - b. Configuration: 2 pole, 3 wire, grounding, .

B. NEMA, 250 V, Locking Receptacle :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
 - b. Leviton Manufacturing Co., Inc.
 - c. Pass & Seymour; Legrand North America, LLC.
 - d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
2. Options:
 - a. Device Color: Black with blue voltage indication on face.
 - b. Configuration: As shown on Drawings.

2.4 CONNECTORS, CORDS, AND PLUGS

A. Outdoor-Use, Watertight, Sealed Cord Connector <Insert drawing designation>:

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. Ericson Manufacturing Company.
2. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
3. General Characteristics:
 - a. Reference Standards: UL CCN AXUT and UL 498.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receptacles:

1. Verify that receptacles to be procured and installed for Owner-furnished equipment are compatible with mating attachment plugs on equipment.

B. Cord Reels:

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF SWITCHES

A. Comply with manufacturer's instructions.

B. Reference Standards:

1. Unless more stringent requirements are specified in Contract Documents or manufacturers' instructions, comply with installation instructions in NECA NEIS 130.
2. Mounting Heights: Unless otherwise indicated in Contract Documents, comply with mounting heights recommended in NECA NEIS 1.
3. Consult Engineer for resolution of conflicting requirements.

C. Identification:

1. Identify cover or cover plate for device with panelboard identification and circuit number in accordance with Section 260553 "Identification for Electrical Systems."
 - a. Mark cover or cover plate using hot, stamped, or engraved machine printing with black -filled lettering, and provide durable wire markers or tags inside device box or outlet box.
 - b. The circuit labels shall be as follows:
 - 1) Normal Power Circuits: Black letters on white background
 - 2) Emergency Power Circuits: White letters on red background
 - 3) Standby Power Circuits: Black letters on orange background

3.3 INSTALLATION OF STRAIGHT-BLADE RECEPTACLES

A. Comply with manufacturer's instructions.

B. Reference Standards:

1. Unless more stringent requirements are specified in Contract Documents or manufacturers' instructions, comply with installation instructions in NECA NEIS 130.
2. Mounting Heights: Unless otherwise indicated in Contract Documents, comply with mounting heights recommended in NECA NEIS 1.
3. Receptacle Orientation: Unless otherwise indicated in Contract Documents, orient receptacle to match configuration diagram in NEMA WD 6.
4. Consult Engineer for resolution of conflicting requirements.

C. Identification:

1. Identify cover or cover plate for device with panelboard identification and circuit number in accordance with Section 260553 "Identification for Electrical Systems."
 - a. Mark cover or cover plate using hot, stamped, or engraved machine printing with black -filled lettering, and provide durable wire markers or tags inside device box or outlet box.

3.4 INSTALLATION OF LOCKING RECEPTACLES

A. Comply with manufacturer's instructions.

B. Reference Standards:

1. Unless more stringent requirements are specified in Contract Documents or manufacturers' instructions, comply with installation instructions in NECA NEIS 130.
2. Mounting Heights: Unless otherwise indicated in Contract Documents, comply with

- mounting heights recommended in NECA NEIS 1.
3. Receptacle Orientation: Unless otherwise indicated in Contract Documents, orient receptacle to match configuration diagram in NEMA WD 6.
 4. Consult Engineer for resolution of conflicting requirements.

C. Identification:

1. Identify cover or cover plate for device with panelboard identification and circuit number in accordance with Section 260553 "Identification for Electrical Systems."
 - a. Mark cover or cover plate using hot, stamped, or engraved machine printing with black -filled lettering, and provide durable wire markers or tags inside device box or outlet box.

3.5 INSTALLATION OF CONNECTORS, CORDS, AND PLUGS

- A. Comply with manufacturer's instructions.

3.6 FIELD QUALITY CONTROL OF SWITCHES

A. Tests and Inspections:

1. Perform tests and inspections in accordance with manufacturers' instructions.

3.7 FIELD QUALITY CONTROL OF STRAIGHT-BLADE RECEPTACLES

A. Tests and Inspections:

1. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.

3.8 PROTECTION

A. Devices:

1. After installation, protect wires and cables, devices, device boxes, outlet boxes, covers, and cover plates from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

B. Connectors, Cords, and Plugs:

1. After installation, protect connectors, cords, and plugs from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 262726

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SECTION 262813

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 the following:
 - a. Control circuits.
 - b. Enclosed controllers.
 - c. Enclosed switches.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Bussmann, an Eaton business.
 - 2. Edison; a brand of Bussmann by Eaton.
 - 3. Littelfuse, Inc.
 - 4. Mersen USA.
- B. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

2.2 CARTRIDGE FUSES

- 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 NEMA FU 1 for cartridge fuses.
- C. Comply with NFPA 70.
- D. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

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. Motor Branch Circuits: Class RK1, time delay.
 - 2. Power Electronics Circuits: Class J, high speed.
 - 3. Other Branch Circuits: Class RK1, time delay.
 - 4. Provide open-fuse indicator fuses or fuse covers with open fuse indication.

3.3 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
- B. Install spare-fuse cabinet(s) in location shown on the Drawings or as indicated in the field by [Architect] [Construction Manager] [Owner].

3.4 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813

SECTION 262816

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 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.

1.2 DEFINITIONS

- A. GFEP: Ground-fault circuit-interrupter for equipment protection.
- B. GFLS: Ground-fault circuit-interrupter for life safety.
- C. SPDT: Single pole, double throw.

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
 - 2. Equipment Room Layouts: Submit dimensioned drawings of all equipment rooms indicating spatial relationships to other proximate equipment. Ensure that all code required clearances are maintained.
 - 3. Enclosure types and details for types other than UL 50E, Type 1.
 - 4. Current and voltage ratings.
 - 5. Short-circuit current ratings (interrupting and withstand, as appropriate).

1.4 CLOSEOUT SUBMITTALS

- A. Warranty documentation.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Spare Parts: Furnish to Owner spare parts, for repairing enclosed switches and circuit

breakers, that are packaged with protective covering for storage on-site 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. ABB, Electrification Business (GE).
 2. Eaton.
 3. Siemens Industry, Inc., Energy Management Division.
 4. Square D; Schneider Electric USA.
- B. Type HD, Heavy Duty:
1. Single throw.
 2. Three pole.
 3. 600 V(ac).
 4. 1200 A and smaller.
 5. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses.
 6. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- 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. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
 4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
 5. Service-Rated Switches: Labeled for use as service equipment.
 6. Lugs: Compression type, suitable for number, size, and conductor material.

2.2 NONFUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ABB, Electrification Business (GE).
 2. Eaton.
 3. Siemens Industry, Inc., Energy Management Division.

4. Square D; Schneider Electric USA.
- B. Type HD, Heavy Duty, Three Pole, Single Throw, 600 V(ac), 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.
- 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. Service-Rated Switches: Labeled for use as service equipment.
 5. Hookstick Handle: Allows use of hookstick to operate handle.
 6. Lugs: Compression type, suitable for number, size, and conductor material.

2.3 SHUNT TRIP SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Bussmann; Eaton, Electrical Sector.
 2. Littelfuse, Inc.
- B. General Requirements: Comply with ASME A17.1, UL 50, and UL 98, with Class J fuse block and 200 kA interrupting and short-circuit current rating.
- C. Type HD, Heavy-Duty, Three Pole, Single-Throw Fusible Switch: 600 V(ac); UL 98 and NEMA KS 1; integral shunt trip mechanism; horsepower rated, with clips or bolt pads to accommodate specified fuses; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.
- D. Control Circuit: 120 V(ac); obtained from integral control power transformer, with primary and secondary fuses, with control power transformer of enough capacity to operate shunt trip, pilot, indicating and control devices.
- E. Accessories:
1. Oiltight key switch for key-to-test function.
 2. Oiltight red ON pilot light.
 3. Isolated neutral lug; 100 percent rating.
 4. Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.
 5. Three-pole, double-throw, fire-safety and alarm relay; 120 V(ac) OR 24 V(dc) coil voltage.
 6. Three-pole, double-throw, fire-alarm voltage monitoring relay complying with NFPA 72 (coordinate with Fire Alarm System installer).
 7. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 8. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
 9. Hookstick Handle: Allows use of hookstick to operate handle.

10. Lugs: Compression type, suitable for number, size, and conductor material.

2.4 MOLDED-CASE CIRCUIT BREAKERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ABB, Electrification Business (GE).
 - 2. Eaton.
 - 3. Siemens Industry, Inc., Energy Management Division.
 - 4. Square D; Schneider Electric USA.
- B. Circuit breakers must be constructed using glass-reinforced insulating material. Current carrying components must be completely isolated from handle and accessory mounting area.
- C. Circuit breakers must have toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. Circuit-breaker handle must be over center, be trip free, and reside in tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon must be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with push-to-trip button, located on face of circuit breaker to mechanically operate circuit-breaker tripping mechanism for maintenance and testing purposes.
- D. Standard: Comply with UL 489 with required interrupting capacity for available fault currents.
- E. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal 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.
- F. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
- G. 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-squared t response.
- H. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.
- I. GFLS Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6 mA trip).
- J. GFEP Circuit Breakers: With Class B ground-fault protection (30 mA trip).
- K. Features and Accessories:
 - 1. Standard frame sizes, trip ratings, and number of poles.
 - 2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting

- circuits.
- 3. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
- 4. Alarm Switch: One NC contact that operates only when circuit breaker has tripped.
- 5. Lugs: Compression type, suitable for number, size, trip ratings, and conductor material.

2.5 MOLDED-CASE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ABB, Electrification Business (GE).
 - 2. Eaton.
 - 3. Siemens Industry, Inc., Energy Management Division.
 - 4. Square D; Schneider Electric USA.
- B. Standard: Comply with UL 489 with interrupting capacity to comply with available fault currents.
- C. Features and Accessories:
 - 1. Standard frame sizes and number of poles.
 - 2. Lugs:
 - a. Compression type, suitable for number, size, trip ratings, and conductor material.
 - 3. Ground-Fault Protection: Comply with UL 1053; remote-mounted and 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.
 - 4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
 - 5. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
 - 6. Alarm Switch: One NC contact that operates only when switch has tripped.

2.6 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, UL 50E, and UL 50, to comply with environmental conditions at installed location.
- B. Enclosure Finish: Enclosure must be finished with gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (UL 50E Type 1).
- C. Conduit Entry: UL 50E Types 4, 4X, and 12 enclosures may not contain knockouts. UL 50E Types 7 and 9 enclosures must be provided with threaded conduit openings in both endwalls.
- D. Operating Mechanism: Circuit-breaker operating handle must be externally operable with operating mechanism being integral part of box, not cover. Cover interlock mechanism must have externally operated override. Override may not permanently disable interlock mechanism, which must return to locked position once override is released. Tool used to override cover interlock mechanism must not be required to enter enclosure in order to override interlock.
- E. Enclosures designated as UL 50E Type 4, 4X stainless steel, 12, or 12K must have dual cover interlock mechanism to prevent unintentional opening of enclosure cover when circuit breaker

is ON and to prevent turning circuit breaker ON when enclosure cover is open.

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 SELECTION OF ENCLOSURES

- A. Indoor, Dry and Clean Locations: UL 50E, Type 1.
- B. Outdoor Locations: UL 50E, Type 3R.
- C. Wash-Down Areas: UL 50E, Type 4X, stainless steel.
- D. Other Wet or Damp, Indoor Locations: UL 50E, Type 4.
- E. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: UL 50E, Type 12.

3.3 INSTALLATION

- A. Comply with manufacturer's published instructions.
- B. Special Techniques:
 - 1. 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.
 - 2. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
 - 3. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
 - 4. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
 - 5. Install fuses in fusible devices.

3.4 IDENTIFICATION

- A. Comply with requirements in Section 260553 "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. Identify with equipment name and panelboard identification and circuit number.

3.5 FIELD QUALITY CONTROL

A. Tests and Inspections for Switches:

1. Visual and Mechanical Inspection:

- a. Inspect physical and mechanical condition. Verify that unit is clean.
- b. Inspect anchorage, alignment, grounding, and clearances.
- c. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
- d. Verify that fuse sizes and types match the Specifications and Drawings.
- e. Verify that each fuse has adequate mechanical support and contact integrity.
- f. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.

B. Tests and Inspections for Molded-Case Circuit Breakers:

1. Visual and Mechanical Inspection:

- a. Verify that equipment nameplate data are as described in the Specifications and shown on Drawings.
- b. Inspect physical and mechanical condition.
- c. Inspect anchorage, alignment, grounding, and clearances.
- d. Verify that unit is clean.
- e. Operate circuit breaker to ensure smooth operation.
- f. Inspect operating mechanism, contacts, and chutes in unsealed units.
- g. Perform adjustments for final protective device settings in accordance with coordination study.

C. Nonconforming Work:

1. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
2. Remove and replace defective units and retest.

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 specified in Section 260673 "Protective Device Study."

3.7 PROTECTION

- A. After installation, protect enclosed switches and circuit breakers from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 262816

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SECTION 262913.03

MANUAL AND MAGNETIC 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.

1.2 SUMMARY

- A. Section Includes:

1. Manual motor controllers.
2. Enclosed full-voltage magnetic motor controllers.
3. Combination full-voltage magnetic motor controllers.
4. Enclosed reduced-voltage magnetic motor controllers.
5. Combination reduced-voltage magnetic motor controllers.
6. Multispeed magnetic motor controllers.
7. Combination multispeed magnetic motor controllers.
8. Enclosures.
9. Identification.

1.3 DEFINITIONS

- A. CPT: Control power transformer.
- B. MCCB: Molded-case circuit breaker.
- C. MCP: Motor circuit protector.
- D. NC: Normally closed.
- E. OCPD: Overcurrent protective device.
- F. SCCR: Short-circuit current rating.
- G. SCPD: Short-circuit protective device.

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.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For magnetic controllers to include in operation and maintenance manuals.
 - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Routine maintenance requirements for magnetic controllers and installed components.
 - b. Manufacturer's written instructions for testing and adjusting circuit breaker and MCP trip settings.
 - c. Manufacturer's written instructions for setting field-adjustable overload relays.
 - d. 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 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. 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.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.

1.8 FIELD CONDITIONS

- A. Ambient Environment Ratings: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - 1. Ambient Temperature: Not less than 23 deg F and not exceeding 104 deg F.
 - 2. Altitude: Not exceeding 4600 feet for electromagnetic and manual devices.

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 use.
- B. UL Compliance: Fabricate and label magnetic motor controllers to comply with UL 508 and UL 60947-4-1.
- C. NEMA Compliance: Fabricate motor controllers to comply with ICS 2.

- D. Seismic Performance: Magnetic controllers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. Component Importance Factor: 1.0.

2.2 MANUAL MOTOR CONTROLLERS

- A. Motor-Starting Switches (MSS): "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.
 - b. General Electric Company (ABB).
 - c. Siemens Industry, Inc., Energy Management Division.
 - d. Square D; by Schneider Electric.
 - e. <Insert manufacturer's name>.
2. Standard: Comply with NEMA ICS 2, general purpose, Class A.
3. Configuration: Nonreversing, Reversing, or Two speed.
4. Surface mounting.
5. Red pilot light.
6. Additional Nameplates: FORWARD and REVERSE for reversing switches.

- B. Fractional Horsepower Manual Controllers (FHPMC): "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.
 - b. General Electric Company (ABB).
 - c. Rockwell Automation, Inc.
 - d. Siemens Industry, Inc., Energy Management Division.
 - e. Square D; by Schneider Electric.
2. Configuration: Nonreversing or Two speed.
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. Pilot Light: Red.

- C. Integral Horsepower Manual Controllers (IHPMC): "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.
 - b. General Electric Company (ABB).
 - c. Rockwell Automation, Inc.
 - d. Siemens Industry, Inc., Energy Management Division.
 - e. Square D; by Schneider Electric.

2. Configuration: Nonreversing or Two speed.
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.

2.3 ENCLOSED FULL-VOLTAGE MAGNETIC MOTOR CONTROLLERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Eaton.
 2. General Electric Company (ABB).
 3. Rockwell Automation, Inc.
 4. Siemens Industry, Inc., Energy Management Division.
 5. Square D; by Schneider Electric.
- B. Standard: Comply with NEMA ICS 2, general purpose, Class A.
- C. Configuration: Nonreversing.
- D. Contactor Coils: Pressure-encapsulated type with coil transient suppressors when indicated.
 1. Operating Voltage: Manufacturer's standard, unless indicated.
- E. Control Power:
 1. For on-board control power, obtain from line circuit or from integral CPT. The CPT shall have capacity to operate integral devices and remotely located pilot, indicating, and control devices.
- F. Overload Relays:
 1. Thermal Overload Relays:
 - a. Inverse-time-current characteristic.
 - b. Class 30 tripping characteristic.
 - c. Heaters in each phase shall be matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
 - d. Ambient compensated.
 - e. Automatic resetting.
 2. Solid-State Overload Relay:
 - a. Switch or dial selectable for motor-running overload protection.
 - b. Sensors in each phase.
 - c. Class 30 tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.

2.4 COMBINATION FULL-VOLTAGE MAGNETIC MOTOR CONTROLLER

- A. Description: Factory-assembled, combination full-voltage magnetic motor controller consisting of the controller described in this article, indicated disconnecting means, SCPD and OCPD, in a single enclosure.

- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton.
 2. General Electric Company (GE).
 3. Rockwell Automation, Inc.
 4. Siemens Industry, Inc., Energy Management Division.
 5. Square D; by Schneider Electric.
- C. Standard: Comply with NEMA ICS 2, general purpose, Class A.
- D. Configuration: Nonreversing.
- E. Contactor Coils: Pressure-encapsulated type.
1. Operating Voltage: Manufacturer's standard, unless indicated.
- F. Control Power:
1. For on-board control power, obtain from line circuit or from integral CPT. The CPT shall have capacity to operate integral devices and remotely located pilot, indicating, and control devices.
- G. Overload Relays:
1. Thermal Overload Relays:
 - a. Inverse-time-current characteristic.
 - b. Class 30 tripping characteristic.
 - c. Heaters in each phase shall be matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
 - d. Ambient compensated.
 2. Solid-State Overload Relay:
 - a. Switch or dial selectable for motor-running overload protection.
 - b. Sensors in each phase.
 - c. Class 30 tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
- H. Fusible Disconnecting Means:
1. NEMA KS 1, heavy-duty, horsepower-rated, fusible switch with clips or bolt pads to accommodate indicated fuses.
 2. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
- I. Nonfusible Disconnecting Means:
1. NEMA KS 1, heavy-duty, horsepower-rated, nonfusible switch.
 2. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
- J. MCP Disconnecting Means:
1. UL 489 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.
- 2. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.

2.5 ENCLOSED REDUCED-VOLTAGE MAGNETIC MOTOR CONTROLLERS

- A. Description: Electrically held; closed-transition; adjustable time delay on transition, 600-V ac or less.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton.
 - 2. General Electric Company (ABB).
 - 3. Rockwell Automation, Inc.
 - 4. Siemens Industry, Inc., Energy Management Division.
 - 5. Square D; by Schneider Electric.
- C. Standard: Comply with NEMA ICS 2, general purpose, Class A.
- D. Configuration:
 - 1. Wye-Delta Controller: Four contactors, with a three-phase starting resistor/reactor bank.
 - 2. Part-Winding Controller: Separate START and RUN contactors, field-selectable for 1/2- or 2/3-winding start mode, with either six- or nine-lead motors; with separate overload relays for starting and running sequences.
 - 3. Autotransformer Reduced-Voltage Controller: Medium-duty service, with integral overtemperature protection; taps for starting at 50, 65, and 80 percent of line voltage; two START and one RUN contactors.
- E. Contactor Coils: Pressure-encapsulated type[with coil transient suppressors when indicated].
 - 1. Operating Voltage: Manufacturer's standard, unless indicated.
- F. Control Power: 24 or 120-V ac; 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.
- G. Overload Relays:
 - 1. Thermal Overload Relays: [Melting alloy type] [Bimetallic type].
 - a. Inverse-time-current characteristic.
 - b. Class 30 tripping characteristic.
 - c. Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
 - 2. Solid-State Overload Relay:
 - a. Switch or dial selectable for motor-running overload protection.
 - b. Sensors in each phase.
 - c. Class 30 tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.

2.6 COMBINATION REDUCED-VOLTAGE MOTOR CONTROLLERS

- A. Description: Factory-assembled, combination reduced-voltage magnetic motor controller consisting of the controller described in this article, indicated disconnecting means, and SCPD and OCPD, in a single enclosure.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton.
 - 2. General Electric Company (GE).
 - 3. Rockwell Automation, Inc.
 - 4. Siemens Industry, Inc., Energy Management Division.
 - 5. Square D; by Schneider Electric.
- C. Configuration:
 - 1. Wye-Delta Controller: Four contactors, with a three-phase starting resistor/reactor bank.
 - 2. Part-Winding Controller: Separate START and RUN contactors, field-selectable for 1/2- or 2/3-winding start mode, with either six- or nine-lead motors; with separate overload relays for starting and running sequences.
 - 3. Autotransformer Reduced-Voltage Controller: Medium-duty service, with integral overtemperature protection; taps for starting at 50, 65, and 80 percent of line voltage; two START and one RUN contactors.
- D. Contactor Coils: Pressure-encapsulated type.
 - 1. Operating Voltage: Manufacturer's standard, unless indicated.
- E. Control Power: 24 or 120-V ac; 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.
- F. Overload Relays:
 - 1. Thermal Overload Relays: [Melting alloy type] [Bimetallic type].
 - a. Inverse-time-current characteristic.
 - b. Class 30 tripping characteristic.
 - c. Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
 - d. Ambient compensated.
 - e. Automatic resetting.
 - 2. Solid-State Overload Relay:
 - a. Switch or dial selectable for motor-running overload protection.
 - b. Sensors in each phase.
 - c. Class 30 tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
- G. Fusible Disconnecting Means:
 - 1. NEMA KS 1, heavy-duty, horsepower-rated, fusible switch with clips or bolt pads to accommodate indicated fuses.

2. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.

H. Nonfusible Disconnecting Means:

1. NEMA KS 1, heavy-duty, horsepower-rated, nonfusible switch.
2. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.

I. MCP Disconnecting Means:

1. UL 489 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.
2. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.

2.7 MULTISPEED MAGNETIC CONTROLLERS

A. Description: Two speed, full voltage, across the line, electrically held.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton.
2. General Electric Company (GE).
3. Rockwell Automation, Inc.
4. Siemens Industry, Inc., Energy Management Division.
5. Square D; by Schneider Electric.

C. Standard: Comply with NEMA ICS 2, general purpose, Class A.

1. Configuration: Nonreversing[, multispeed].
2. Contactor Coils: Pressure-encapsulated type[with coil transient suppressors].
 - a. Operating Voltage: Manufacturer's standard, unless indicated.
3. Power Contacts: Totally enclosed, double break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
4. Control Power: 24 or 120-V ac; 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.
5. Compelling relays shall ensure that motor will start only at low speed.
6. Accelerating timer relays shall ensure properly timed acceleration through speeds lower than that selected.
7. Decelerating timer relays shall ensure automatically timed deceleration through each speed.
8. Antiplugging timer relays shall ensure a time delay when transferring from FORWARD to REVERSE and back.

D. Overload Relays:

1. Thermal Overload Relays: Melting alloy type or Bimetallic type.
 - a. Inverse-time-current characteristic.
 - b. Class 30 tripping characteristic.
 - c. Heaters in each phase matched to nameplate full-load current of actual protected

- motor and with appropriate adjustment for duty cycle.
- d. Ambient compensated.
- e. Automatic resetting.

2. Solid-State Overload Relay:

- a. Switch or dial selectable for motor-running overload protection.
- b. Sensors in each phase.
- c. Class 30 tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.

2.8 COMBINATION MULTISPEED MAGNETIC MOTOR CONTROLLER

- A. Description: Factory-assembled, combination of multispeed magnetic motor controller, consisting of the controller, indicated disconnecting means, and SCPD and OCPD, in a single enclosure.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton.
 - 2. General Electric Company (GE).
 - 3. Rockwell Automation, Inc.
 - 4. Siemens Industry, Inc., Energy Management Division.
 - 5. Square D; by Schneider Electric.
- C. Standard: Comply with NEMA ICS 2, general purpose, Class A.
 - 1. Configuration: Nonreversing or Reversing; consequent pole.
 - 2. Contactor Coils: Pressure-encapsulated type[with coil transient suppressors].
 - a. Operating Voltage: Manufacturer's standard, unless indicated.
 - 3. Power Contacts: Totally enclosed, double break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
 - 4. Control Power: 24 or 120-V ac; 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.
 - 5. Compelling relays shall ensure that motor will start only at low speed.
 - 6. Accelerating timer relays shall ensure properly timed acceleration through speeds lower than that selected.
 - 7. Decelerating timer relays shall ensure automatically timed deceleration through each speed.
 - 8. Antiplugging timer relays shall ensure a time delay when transferring from FORWARD to REVERSE and back.
- D. Overload Relays:
 - 1. Thermal Overload Relays: Melting alloy type or Bimetallic type.
 - a. Inverse-time-current characteristic.
 - b. Class 30 tripping characteristic.
 - c. Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.

- d. Ambient compensated.
 - e. Automatic resetting.
- 2. Solid-State Overload Relay:
 - a. Switch or dial selectable for motor-running overload protection.
 - b. Sensors in each phase.
 - c. Class 30 tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
- E. Fusible Disconnecting Means:
 - 1. NEMA KS 1, heavy-duty, horsepower-rated, fusible switch with clips or bolt pads to accommodate indicated fuses.
 - 2. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
 - 3. NEMA KS 1, heavy-duty, horsepower-rated, nonfusible switch.
 - 4. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
- F. MCP Disconnecting Means:
 - 1. UL 489 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.
 - 2. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.

2.9 ENCLOSURES

- A. Comply with NEMA 250, type designations as indicated on Drawings, complying with environmental conditions at installed location.
- B. The construction of the enclosures shall comply with NEMA ICS 6.
- C. Controllers in hazardous (classified) locations shall comply with UL 1203.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and space conditions for compliance with requirements for motor controllers, their relationship with the motors, and other conditions affecting performance of the Work.

3.2 INSTALLATION

- A. Comply with NECA 1.
- B. Wall-Mounted Controllers: Install magnetic controllers on walls with tops at uniform height 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 Section 260529 "Hangers and Supports for Electrical Systems" unless otherwise indicated.
- C. Floor-Mounted Controllers: Install controllers on cast-in-place concrete equipment base(s).

Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."

- D. Comply with requirements for seismic control devices specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- E. Maintain minimum clearances and workspace at equipment according to manufacturer's written instructions and NFPA 70.
- F. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
- G. Setting of Overload Relays: Select and set overloads on the basis of full-load current rating as shown on motor nameplate. Adjust setting value for special motors as required by NFPA 70 for motors that are high-torque, high-efficiency, and so on.

3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 SYSTEM FUNCTION TESTS

- A. System function tests shall prove the correct interaction of sensing, processing, and action devices. Perform system function tests after field quality control tests have been completed and all components have passed specified tests.
 - 1. Develop test parameters and perform tests for the purpose of evaluating performance of integral components and their functioning as a complete unit within design requirements and manufacturer's published data.
 - 2. Verify the correct operation of interlock safety devices for fail-safe functions in addition to design function.
 - 3. Verify the correct operation of sensing devices, alarms, and indicating devices.
- B. Motor controller will be considered defective if it does not pass the system function tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION 262913.03

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SECTION 264313

SURGE PROTECTIVE DEVICES FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Type 1 surge protective devices.
2. Type 2 surge protective devices.
3. Enclosures.
4. Conductors and cables.

B. Related Requirements:

1. Section 262413 "Switchboards" for integral SPDs installed by switchboard manufacturer.
2. Section 262416 "Panelboards" for integral SPDs installed by panelboard manufacturer.

1.2 DEFINITIONS

- A. In: Nominal discharge current.
- B. Maximum Continuous Operating Voltage (MCOV): The maximum designated RMS value of the power frequency voltage that may be continuously applied to the mode of protection of an SPD.
- C. Metal-Oxide Varistor (MOV): An electronic component with a significant bidirectional, nonlinear current-voltage characteristic.
- D. Mode(s), Modes of Protection, or Protection Modes: Electrical paths where the SPD offers defense against transient overvoltages. Examples include: line to neutral (L-N), line to ground (L-G), line to line (L-L), and neutral to ground (N-G).
- E. SCCR: Short-circuit current rating.
- F. Type 1 SPDs: Permanently connected SPDs intended for installation between the secondary of the service transformer and the line side of the service disconnect overcurrent device.
- G. Type 2 SPDs: Permanently connected SPDs intended for installation on the load side of the service disconnect overcurrent device, including SPDs located at the branch panel.
- H. Type 3 SPDs: Point of utilization SPDs.
- I. Type 4 SPDs: Component SPDs, including discrete components, as well as assemblies.
- J. Type 5 SPDs: Discrete component surge suppressors, such as MOVs that may be mounted on a printed wiring board, connected by its leads or provided within an enclosure with mounting means and wiring terminations.

- K. Voltage Protection Rating (VPR): A rating selected from UL 1449 list of preferred values assigned to each mode of protection.

1.3 ACTION SUBMITTALS

- A. Product Data:

- 1. For each type of product.

1.4 WARRANTY

- A. Manufacturer Extended Warranty: Manufacturer warrants that SPDs perform in accordance with specified requirements and agrees to provide repair or replacement of SPDs that fail to perform as specified within extended warranty period.

- 1. Initial Extended Warranty Period: Five year(s) from date of Substantial Completion, for labor, materials, and equipment.

PART 2 - PRODUCTS

2.1 TYPE 1 SURGE PROTECTIVE DEVICES (SPDs)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1. ABB (Electrification Products Division)/GE.
 - 2. Eaton.
 - 3. Schneider Electric USA, Inc.
 - 4. Siemens Industry, Inc., Energy Management Division.

- B. Source Limitations: Obtain devices from single source from single manufacturer.

- C. General Characteristics:

- 1. Reference Standards: UL 1449, Type 1.
 - 2. MCOV: Not less than 125 percent of nominal system voltage for 208Y/120 V and 120/240 V power systems, and not less than 115 percent of nominal system voltage for 480Y/277 V power systems.
 - 3. Peak Surge Current Rating: Minimum single-pulse surge current withstand rating per phase must not be less than 200 kA. Peak surge current rating must be arithmetic sum of the ratings of individual MOVs in a given mode.
 - 4. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V and 208Y/120 V, three-phase, four-wire circuits must not exceed the following:
 - a. Line to Neutral: 1200 V for 480Y/277 V, 700 V for 208Y/120 V.
 - b. Line to Line: 2000 V for 480Y/277 V, 1200 V for 208Y/120 V.
 - 5. Protection modes and UL 1449 VPR for 240/120 V, single-phase, three-wire circuits must not exceed the following:

- a. Line to Neutral: 700 V.
 - b. Line to Line: 1200 V.
- 6. SCCR: Not less than 200 kA.
 - 7. In Rating: 20 kA.

2.2 TYPE 2 SURGE PROTECTIVE DEVICES (SPDs)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ABB (Electrification Products Division)/GE.
 - 2. Eaton.
 - 3. Schneider Electric USA, Inc.
 - 4. Siemens Industry, Inc., Energy Management Division.
- B. General Characteristics:
 - 1. Reference Standards: UL 1449, Type 2; UL 1283.
 - 2. MCOV: Not less than 125 percent of nominal system voltage for 208Y/120 V and 120/240 V power systems, and not less than 115 percent of nominal system voltage for 480Y/277 V power systems.
 - 3. Peak Surge Current Rating: Minimum single-pulse surge current withstand rating per phase must not be less than 100 kA. Peak surge current rating must be arithmetic sum of the ratings of individual MOVs in a given mode.
 - 4. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V and 208Y/120 V, three-phase, four-wire circuits must not exceed the following:
 - a. Line to Neutral: 1200 V for 480Y/277 V, 700 V for 208Y/120 V.
 - b. Line to Ground: 1200 V for 480Y/277 V, 700 V for 208Y/120 V.
 - c. Neutral to Ground: 1200 V for 480Y/277 V, 700 V for 208Y/120 V.
 - d. Line to Line: 2000 V for 480Y/277 V, 1200 V for 208Y/120 V.
 - 5. Protection modes and UL 1449 VPR for 240/120 V, single-phase, three-wire circuits must not exceed the following:
 - a. Line to Neutral: 700 V.
 - b. Line to Ground: 700 V.
 - c. Neutral to Ground: 700 V.
 - d. Line to Line: 1200 V.
 - 6. SCCR: Equal or exceed 200 kA.
 - 7. In Rating: 20 kA.

2.3 ENCLOSURES

- A. Indoor Enclosures: Type 1.
- B. Outdoor Enclosures: Type 3R.

2.4 CONDUCTORS AND CABLES

- A. Power Wiring: Same size as SPD leads, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide OCPD and disconnect for installation of SPD in accordance with UL 1449 and manufacturer's instructions.
- B. Install leads between disconnects and SPDs short, straight, twisted, and in accordance with manufacturer's instructions. Comply with wiring methods in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
 - 1. Do not splice and extend SPD leads unless specifically permitted by manufacturer.
 - 2. Do not exceed manufacturer's recommended lead length.
 - 3. Do not bond neutral and ground.
- C. Use crimped connectors and splices only. Wire nuts are unacceptable.

3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Verify that electrical wiring installation complies with manufacturer's installation requirements.

3.3 STARTUP SERVICE

- A. Complete startup checks in accordance with manufacturer's instructions.
- B. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests; reconnect them immediately after the testing is over.
- C. Energize SPDs after power system has been energized, stabilized, and tested.

END OF SECTION 264313

SECTION 265119

LED 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 LED luminaires.
- 2. Luminaire support.

- B. Related Requirements:

- 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 260943.23 "Relay-Based Lighting Controls" for manual or programmable control systems with low-voltage control wiring or data communication circuits.

1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Arrange in order of luminaire designation.
 - 2. Include data on features, accessories, and finishes.

3. Include physical description and dimensions of luminaires.
4. Include emergency lighting units, including batteries and chargers.
5. Include life, output (lumens, CCT, and CRI), and energy-efficiency data.
6. Photometric data and adjustment factors based on laboratory tests, complying with IES "Lighting Measurements Testing and Calculation Guides" for each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and lighting systems 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. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.

1.7 QUALITY ASSURANCE

- A. Provide luminaires from a single manufacturer for each luminaire type.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.9 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide products indicated on Drawings.
- B. All manufacturers listed in the Light Fixture Schedule must meet luminaire performance for specified energy use.

2.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance:

1. Luminaires shall withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7.
2. Luminaires and lamps shall be labeled vibration and shock resistant.
3. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified."

B. Ambient Temperature: 41 to 104 deg F.

1. Relative Humidity: Zero to 95 percent.

C. Altitude: Sea level to 4600 feet.

2.3 LUMINAIRE 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. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels 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 characteristics:
 - a. "USE ONLY" and include specific lamp type.
 - b. Lamp diameter, shape, size, wattage, and coating.
 - c. CCT and CRI.

C. Recessed luminaires shall comply with NEMA LE 4.

2.4 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Steel:

1. ASTM A36/A36M for carbon structural steel.
2. ASTM A568/A568M for sheet steel.

C. Stainless Steel:

1. Manufacturer's standard grade.
2. Manufacturer's standard type, ASTM A240/240M.

D. Galvanized Steel: ASTM A653/A653M.

- E. Aluminum: ASTM B209.

2.5 METAL FINISHES

- A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.6 LUMINAIRE SUPPORT

- A. Comply with requirements in 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 steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
- C. Wires: ASTM A641/A641M, Class 3, soft temper, zinc-coated steel, 12 gage.
- D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

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 the Work.
- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

- A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

3.3 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires per manufacturers recommendations and installation instructions.
- C. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

- D. Install lamps in each luminaire.
- E. Supports:
 - 1. Sized and rated for luminaire weight.
 - 2. Able to maintain luminaire position after cleaning and relamping.
 - 3. Provide support for luminaire without causing deflection of ceiling or wall.
 - 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.
- F. Flush-Mounted Luminaires:
 - 1. Secured to outlet box.
 - 2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
 - 3. Trim ring flush with finished surface.
- G. Wall-Mounted Luminaires:
 - 1. Attached to structural members in walls.
 - 2. Do not attach luminaires directly to gypsum board.
- H. Suspended Luminaires:
 - 1. Ceiling Mount:
 - a. Four 5/32-inch- diameter aircraft cable supports adjustable to fixture heights shown in Drawings.
 - b. Pendant mount with diameter aircraft cable supports adjustable to fixture heights shown in .
 - c. Hook mount.
 - 2. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
 - 3. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
 - 4. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of luminaire chassis, including one at each end.
 - 5. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.
- I. Ceiling-Grid-Mounted Luminaires:
 - 1. Secure to any required outlet box.
 - 2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
- J. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for

identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
 - 2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation.
- B. Luminaire will be considered defective if it does not pass operation tests and inspections.
- C. Prepare test and inspection reports.

3.6 STARTUP SERVICE

- A. Comply with requirements for startup specified in Section 260943.23 "Relay-Based Lighting Controls."

3.7 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
 - 1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
 - 2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 - 3. Adjust the aim of luminaires in the presence of the Architect or Owner's representative.

END OF SECTION 265119

SECTION 265613
LIGHTING POLES AND STANDARDS

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. Poles and accessories for support of luminaires.

1.3 DEFINITIONS

- A. EPA: Equivalent projected area.
- B. Luminaire: Complete luminaire.
- C. Pole: Luminaire-supporting structure, including tower used for large-area illumination.
- D. Standard: See "Pole."

1.4 ACTION SUBMITTALS

- A. Product Data: For each pole, accessory, and luminaire-supporting and -lowering device, arranged as indicated.
 - 1. Include data on construction details, profiles, EPA, cable entrances, materials, dimensions, weight, rated design load, and ultimate strength of individual components.
 - 2. Include finishes for lighting poles and luminaire-supporting devices.
 - 3. Anchor bolts.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For poles to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include pole inspection and repair procedures.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store poles on decay-resistant skids at least 12 inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.
- B. Retain factory-applied pole wrappings on metal poles until right before pole installation. Handle poles with web fabric straps.

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of pole(s) 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 a specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs from special warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.
 - 2. Warranty Period for Corrosion Resistance: Five years from date of Substantial Completion.
 - 3. Warranty Period for Color Retention: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Foundation and pole shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. Component Importance Factor: 1.0.
 - 2. .
- B. Structural Characteristics: Comply with AASHTO LTS-6-M.
- C. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied according to AASHTO LTS-6-M.
- D. Strength Analysis: For each pole, multiply the actual EPA of luminaires and brackets by a factor of 1.1 to obtain the EPA to be used in pole selection strength analysis.
- E. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts unless otherwise indicated.

2.2 STEEL POLES

- A. Source Limitations: Obtain poles from single manufacturer or producer.
- B. Source Limitations: For poles, obtain each color, grade, finish, type, and variety of pole from single source with resources to provide products of consistent quality in appearance and physical properties.

- C. Poles: Comply with ASTM A 500/A 500M, Grade B carbon steel with a minimum yield of 46,000 psig; one-piece construction up to 40 feet in height with access handhole in pole wall.
 - 1. Shape: Round, tapered.
 - 2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.
- D. Steel Mast Arms: Single-arm type, continuously welded to pole attachment plate. Material and finish same as plate.
- E. Brackets for Luminaires: Detachable, cantilever, without underbrace.
- F. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.
- G. Fasteners: Galvanized steel, size and type as determined by manufacturer. Corrosion-resistant items compatible with support components.
 - 1. Materials: Compatible with poles and standards as well as the substrates to which poles and standards are fastened and 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.
- H. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Section 260526 "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size indicated, and accessible through handhole.
- I. Intermediate Handhole and Cable Support: Weatherproof, 3-by-5-inch handhole located at midpoint of pole, with cover for access to internal welded attachment lug for electric cable support grip.
- J. 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 load multiplied by a 5.0 safety factor.
- K. Factory-Painted Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.
 - 1. 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.

2.3 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

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 poles, luminaire-mounting devices, lowering devices, and pole accessories before installation. Components that are scratched, dented, marred, wet, moisture damaged, or visibly damaged are considered defective.
- C. Examine roughing-in for foundation and conduit to verify actual locations of installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 POLE FOUNDATION

- A. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Structural steel complying with ASTM A 36/A 36M and hot-dip galvanized according to ASTM A 123/A 123 M; and with top-plate and mounting bolts to match pole-base flange and strength required to support pole, luminaire, and accessories. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."

3.3 POLE INSTALLATION

- A. Alignment: Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on pole.
- B. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are specified in Section 033000 "Cast-in-Place Concrete."
- C. Foundation-Mounted Poles: Mount pole with leveling nuts and tighten top nuts to torque level according to pole manufacturer's written instructions.
 - 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 diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.
- D. Raise and set pole using web fabric slings (not chain or cable) at locations indicated by manufacturer.

3.4 CORROSION PREVENTION

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum using insulating fittings or treatment.
- B. Steel Conduits: Comply with requirements in Section 260533 "Raceways and Boxes for

Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- thick, pipe-wrapping plastic tape applied with a 50-percent overlap.

3.5 GROUNDING

- A. Ground Metal Poles and Support Structures: Comply with requirements in Section 260526 "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.

3.6 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.7 FIELD QUALITY CONTROL

- A. Perform the following special inspections:
 - 1. Inspect poles for nicks, mars, dents, scratches, and other damage.
 - 2. System function tests.

END OF SECTION 26513

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SECTION 265619

LED 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 solid-state luminaires that are designed for and exclusively use LED lamp technology.
2. Luminaire supports.
3. Luminaire-mounted photoelectric relays.

B. Related Requirements:

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 260943.23 "Relay-Based Lighting Controls" for manual or programmable control systems with low-voltage control wiring or data communication circuits.

1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color rendering index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. Lumen: Measured output of lamp and luminaire, or both.
- F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of luminaire.
 1. Arrange in order of luminaire designation.
 2. Include data on features, accessories, and finishes.

3. Include physical description and dimensions of luminaire.
4. Lamps, include life, output (lumens, CCT, and CRI), and energy-efficiency data.
5. Photometric data and adjustment factors based on laboratory tests, complying with IES Lighting Measurements Testing and Calculation Guides, of each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project.
6. Means of attaching luminaires to supports and indication that the attachment is suitable for components involved.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and photoelectric relays to include in operation and maintenance manuals.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.

1.7 FIELD CONDITIONS

- A. Verify existing and proposed utility structures prior to the start of work associated with luminaire installation.
- B. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.

1.8 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Structural failures, including luminaire support components.
 - b. Faulty operation of luminaires and accessories.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 2. Warranty Period: 5 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide products indicated on Drawings.
- B. All manufacturers listed in the Light Fixture Schedule must meet luminaire performance for

specified energy use.

2.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

2.3 LUMINAIRE 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. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.
- C. UL Compliance: Comply with UL 1598 and listed for wet location.
- D. Lamp base complying with ANSI C81.61 or IEC 60061-1.
- E. In-line Fusing: On the primary for each luminaire.
- F. Source Limitations: Obtain luminaires from single source from a single manufacturer.

2.4 LUMINAIRE-MOUNTED PHOTOELECTRIC RELAYS

- A. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc and off at 4.5 to 10 fc with 15-second minimum time delay. Relay shall have directional lens in front of photocell to prevent artificial light sources from causing false turnoff.
 - 1. Relay with locking-type receptacle shall comply with ANSI C136.10.
 - 2. Adjustable window slide for adjusting on-off set points.

2.5 MATERIALS

- A. Metal Parts: Free of burrs and sharp corners and edges.
- B. 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.
- C. Housings:
 - 1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.
 - 2. Provide filter/breather for enclosed luminaires.

D. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. 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 characteristics:
 - a. "USE ONLY" and include specific lamp type.
 - b. Lamp diameter, shape, size, wattage and coating.
 - c. CCT and CRI for all luminaires.

2.6 FINISHES

- A. Refer to Drawings.
- B. All finishes shall be factory applied.

2.7 LUMINAIRE SUPPORT COMPONENTS

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

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 the Work.
- B. Examine roughing-in for luminaire electrical conduit to verify actual locations of conduit connections before luminaire installation.
- C. Examine walls, roofs, and canopy ceilings for suitable conditions where luminaires will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

- A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is substantially complete, clean luminaires used for temporary lighting and install new lamps.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Comply with NECA 1.
- B. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

- C. Fasten luminaire to structural support.
- D. Supports:
 - 1. Sized and rated for luminaire weight.
 - 2. Able to maintain luminaire position after cleaning and relamping.
 - 3. Support luminaires without causing deflection of finished surface.
 - 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.
- E. Wall-Mounted Luminaire Support:
 - 1. Attached to structural members in walls.
- F. Wiring Method: Install cables in raceways. Conceal raceways and cables.
- G. Install luminaires level, plumb, and square with finished grade unless otherwise indicated.
- H. Coordinate layout and installation of luminaires with other construction.
- I. 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.
- J. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and Section 260533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

3.4 CORROSION PREVENTION

- A. Steel Conduits: Comply with Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.5 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.6 FIELD QUALITY CONTROL

- A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.
- B. Perform the following tests and inspections:
 - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
 - 2. Verify operation of photoelectric controls.
- C. Luminaire will be considered defective if it does not pass tests and inspections.
- D. 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.

3.7 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
 - 1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
 - 2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 - 3. Adjust the aim of luminaires in the presence of the Architect and Owner's representative.

END OF SECTION 265619

SECTION 270526.22

GROUNDING AND BONDING FOR COMMUNICATIONS 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. Grounding conductors.
 - 2. Grounding connectors.
 - 3. Grounding busbars.
 - 4. Grounding labeling.

1.3 DEFINITIONS

- A. BCT: Bonding conductor for telecommunications.
- B. TGB: Telecommunications grounding busbar.
- C. TMGB: Telecommunications main grounding busbar.
- D. Service Provider: The operator of a service that provides telecommunications transmission delivered over access provider facilities.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.5 INFORMATIONAL SUBMITTALS

- A. As-Buins showing as-built locations of grounding and bonding infrastructure, including the following:
 - 1. BCT, TMGB, TGBs, and routing of their bonding conductors.
- B. Qualification Data: For Installer, Installation supervisor, and field inspector.
- C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For grounding 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. Result of the ground-resistance test, measured at the point of BCT connection.
 - b. Result of the bonding-resistance test at each TGB and its nearest grounding electrode.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
 - 1. Installation Supervision: Installation shall be under the direct supervision of ITS Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.
 - 2. Field Inspector: Currently registered by BICSI as a designer RCDD to perform the on-site inspection.

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.
- B. Comply with UL 467 for grounding and bonding materials and equipment.
- C. Comply with TIA-607-B.

2.2 CONDUCTORS

- A. Comply with UL 486A-486B.
- B. Insulated Conductors: Stranded copper wire, green or green with yellow stripe insulation, insulated for 600 V, and complying with UL 83.
 - 1. Ground wire for custom-length equipment ground jumpers shall be No. 6 AWG, 19-strand, UL-listed, Type THHN wire.
 - 2. Cable Tray Equipment Grounding Wire: No. 6 AWG.
- C. Cable Tray Grounding Jumper:
 - 1. Not smaller than No. 6 AWG and not longer than 12 inches. If jumper is a wire, it shall have a crimped grounding lug with two holes and long barrel for two crimps. If jumper is a flexible braid, it shall have a one-hole ferrule. Attach with grounding screw or connector provided by cable tray manufacturer.

D. 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 kcmils, 14 strands of No. 17 AWG conductor, and 1/4 inch in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Tinned-copper tape, braided conductors terminated with two-hole copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

2.3 CONNECTORS

- A. Irreversible connectors listed for the purpose. Listed by an NRTL as complying with NFPA 70 for specific types, sizes, and combinations of conductors and other items connected. Comply with UL 486A-486B.
- B. Compression Wire Connectors: Crimp-and-compress connectors that bond to the conductor when the connector is compressed around the conductor. Comply with UL 467.
1. Electroplated tinned copper, C and H shaped.
- C. Signal Reference Grid Connectors: Combination of compression wire connectors, access floor grounding clamps, bronze U-bolt grounding clamps, and copper split-bolt connectors, designed for the purpose.
- D. Busbar Connectors: Cast silicon bronze, solderless exothermic-type, mechanical connector; with a long barrel and two holes spaced on 5/8- or 1-inch centers for a two-bolt connection to the busbar.
- E. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.4 GROUNDING BUSBARS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Chatsworth Products, Inc.
 2. Harger Lightning & Grounding.
 3. Panduit Corp.
- B. TMGB: Predrilled, wall-mounted, rectangular bars of hard-drawn solid copper, 1/4 by 4 inches in cross section, length as indicated on Drawings. The busbar shall be NRTL listed for use as TMGB and shall comply with TIA-607-B.
1. Predrilling shall be with holes for use with lugs specified in this Section.
 2. Mounting Hardware: Stand-off brackets that provide a 4-inch clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.
- C. TGB: Predrilled rectangular bars of hard-drawn solid copper, 1/4 by 2 inches in cross section, length as indicated on Drawings. The busbar shall be for wall mounting, shall be NRTL listed as

complying with UL 467, and shall comply with TIA-607-B.

1. Predrilling shall be with holes for use with lugs specified in this Section.
2. Mounting Hardware: Stand-off brackets that provide at least a 4-inch clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.
3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.

2.5 IDENTIFICATION

- A. Comply with requirements for identification products in Section 270553 "Identification for Communications Systems."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the ac grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of the electrical system.
- B. Inspect the test results of the ac grounding system measured at the point of BCT connection.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with connection of the BCT only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Bonding shall include the ac utility power service entrance, the communications cable entrance, and the grounding electrode system. The bonding of these elements shall form a loop so that each element is connected to at least two others.
- B. Comply with NECA 1.
- C. Comply with TIA-607-B.

3.3 APPLICATION

- A. Conductors: Install solid conductor for No. 8 AWG and smaller and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
 1. The bonding conductors between the TGB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.
 2. The bonding conductors between the TMGB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.

- B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2 AWG

minimum.

C. 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.

D. Conductor Support:

1. Secure grounding and bonding conductors at intervals of not less than 36 inches.

E. Grounding and Bonding Conductors:

1. Install in the straightest and shortest route between the origination and termination point, and no longer than required. The bend radius shall not be smaller than eight times the diameter of the conductor. No one bend may exceed 90 degrees.
2. Install without splices.
3. Support at not more than 36-inch intervals.
4. Install grounding and bonding conductors in 3/4-inch PVC conduit until conduit enters a telecommunications room. The grounding and bonding conductor pathway through a plenum shall be in EMT. Conductors shall not be installed in EMT unless otherwise indicated.
 - a. If a grounding and bonding conductor is installed in ferrous metallic conduit, bond the conductor to the conduit using a grounding bushing that complies with requirements in Section 270528 "Pathways for Communications Systems," and bond both ends of the conduit to a TGB.

3.4 GROUNDING ELECTRODE SYSTEM

- A. The BCT between the TMGB and the ac service equipment ground shall not be smaller than No. 3/0 AWG.

3.5 GROUNDING BUSBARS

- A. Indicate locations of grounding busbars on Drawings. Install busbars horizontally, on insulated spacers 4 inches minimum from wall, 12 inches above finished floor unless otherwise indicated.
- B. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

3.6 CONNECTIONS

- A. Bond metallic equipment in a telecommunications equipment room to the grounding busbar in that room, using equipment grounding conductors not smaller than No. 6 AWG.
- B. Stacking of conductors under a single bolt is not permitted when connecting to busbars.

- C. Assemble the wire connector to the conductor, complying with manufacturer's written instructions and as follows:
 - 1. Use crimping tool and the die specific to the connector.
 - 2. Pretwist the conductor.
 - 3. Apply an antioxidant compound to all bolted and compression connections.
- D. Primary Protector: Bond to the TMGB with insulated bonding conductor.
- E. Telecommunications Enclosures and Equipment Racks: Bond metallic components of enclosures to the telecommunications bonding and grounding system. Install vertically mounted rack grounding busbar unless the enclosure and rack are manufactured with the busbar. Bond the equipment grounding busbar to the TGB No. 2 AWG bonding conductors.
- F. Structural Steel: Where the structural steel of a steel frame building is readily accessible within the room or space, bond each TGB and TMGB to the vertical steel of the building frame.
- G. Electrical Power Panelboards: Where an electrical panelboard for telecommunications equipment is located in the same room or space, bond each TGB to the ground bar of the panelboard.
- H. Shielded Cable: Bond the shield of shielded cable to the TGB in communications rooms and spaces. Comply with TIA-568-C.1 and TIA-568-C.2 when grounding shielded balanced twisted-pair cables.
- I. Rack- and Cabinet-Mounted Equipment: Bond powered equipment chassis to the cabinet or rack grounding bar. Power connection shall comply with NFPA 70; the equipment grounding conductor in the power cord of cord- and plug-connected equipment shall be considered as a supplement to bonding requirements in this Section.

3.7 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.

3.8 IDENTIFICATION

- A. Labels shall be preprinted or computer-printed type.
 - 1. Label TMGB(s) with "fs-TMGB," where "fs" is the telecommunications space identifier for the space containing the TMGB.
 - 2. Label TGB(s) with "fs-TGB," where "fs" is the telecommunications space identifier for the space containing the TGB.
 - 3. Label the BCT and each telecommunications backbone conductor at its attachment point: "WARNING! TELECOMMUNICATIONS BONDING CONDUCTOR. DO NOT REMOVE OR DISCONNECT!"

3.9 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:

1. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 2. Test the bonding connections of the system using an ac earth ground-resistance tester, taking two-point bonding measurements in each telecommunications equipment room containing a TMGB and a TGB and using the process recommended by BICSI TDMM. Conduct tests with the facility in operation.
 - a. Measure the resistance between the busbar and the nearest available grounding electrode. The maximum acceptable value of this bonding resistance is 100 milliohms.
 3. Test for ground loop currents using a digital clamp-on ammeter, with a full-scale of not more than 10 A, displaying current in increments of 0.01 A at an accuracy of plus/minus 2.0 percent.
 - a. With the grounding infrastructure completed and the communications system electronics operating, measure the current in every conductor connected to the TMGB and in each TGB. Maximum acceptable ac current level is 1 A.
- C. Excessive Ground Resistance: If resistance to ground at the BCT exceeds 5 ohms, notify Architect promptly and include recommendations to reduce ground resistance.
- D. Grounding system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

END OF SECTION 270526.22

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SECTION 270528

PATHWAYS FOR COMMUNICATIONS 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.
 - 2. Nonmetallic conduits and fittings.
 - 3. Optical-fiber-cable pathways and fittings.
 - 4. Hooks.
 - 5. Boxes, enclosures, and cabinets.
 - 6. Polymer-concrete handholes and boxes for exterior underground cabling.

1.3 DEFINITIONS

- A. ARC: Aluminum rigid conduit.
- B. GRC: Galvanized rigid conduit.
- C. IMC: Intermediate metal conduit.
- D. RTRC: Reinforced thermosetting resin conduit.

1.4 ACTION SUBMITTALS

- A. Product data for the following:
 - 1. Boxes, enclosures, and cabinets.
 - 2. Underground handholes and boxes.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

- A. Description: Metal raceway of circular cross section with manufacturer-fabricated fittings.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems; a part of Atkore International.
2. Allied Tube & Conduit; a part of Atkore International.
3. Alpha Wire.
4. Anamet Electrical, Inc.
5. Electri-Flex Company.
6. O-Z/Gedney; a brand of Emerson Industrial Automation.
7. Picoma Industries, Inc.
8. Plasti-Bond.
9. Republic Conduit.
10. Southwire Company.
11. Thomas & Betts Corporation; A Member of the ABB Group.
12. Western Tube and Conduit Corporation.
13. Wheatland Tube Company.

C. General Requirements for Metal Conduits and Fittings:

1. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.
2. Comply with TIA-569-D.

D. GRC: Comply with ANSI C80.1 and UL 6.

E. PVC-Coated Steel Conduit: PVC-coated GRC.

1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch, minimum.

F. EMT: Comply with ANSI C80.3 and UL 797.

G. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Fittings for EMT:
 - a. Material: Steel.
 - b. Type: compression.
2. Expansion Fittings: PVC or steel to match conduit type, complying with UL-467, rated for environmental conditions where installed, and including flexible external bonding jumper.
3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.

H. Joint Compound for IMC or 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 CONDUITS AND FITTINGS

A. Description: Nonmetallic raceway of circular section with manufacturer-fabricated fittings.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems; a part of Atkore International.
2. Allied Tube & Conduit; a part of Atkore International.

3. Anamet Electrical, Inc.
4. Arnco Corporation.
5. CANTEX INC.
6. Carlon; a brand of Thomas & Betts Corporation.
7. CertainTeed Corporation.
8. Condux International, Inc.
9. Dura-Line.
10. Electri-Flex Company.
11. Kraloy.
12. Lamson & Sessions.
13. Niedax Inc.
14. RACO; Hubbell.
15. Thomas & Betts Corporation; A Member of the ABB Group.

C. General Requirements for Nonmetallic Conduits and Fittings:

1. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
2. Comply with TIA-569-D.

D. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

E. Fittings: Comply with NEMA TC 3; match to conduit or tubing type and material.

F. Solvents and Adhesives: As recommended by conduit manufacturer.

2.3 OPTICAL-FIBER-CABLE PATHWAYS AND FITTINGS

A. Description: Comply with UL 2024; flexible-type pathway with a circular cross section, approved for general-use installation unless otherwise indicated.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Alpha Wire.
2. Carlon; a brand of Thomas & Betts Corporation.
3. Dura-Line.
4. Endot Industries Inc.
5. IPEX USA LLC.

C. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

D. Comply with TIA-569-D.

2.4 HOOKS

A. Description: Prefabricated sheet metal cable supports for telecommunications cable.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. MonoSystems, Inc.

2. Panduit Corp.
 3. Wiremold / Legrand.
- C. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- D. Comply with TIA-569-D.
- E. Stainless steel.
- F. J shape.

2.5 BOXES, ENCLOSURES, AND CABINETS

- A. Description: Enclosures for communications.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Carlon; a brand of Thomas & Betts Corporation.
 2. Crouse-Hinds, an Eaton business.
 3. Erickson Electrical Equipment Company.
 4. FSR Inc.
 5. Hoffman; a brand of Pentair Equipment Protection.
 6. MonoSystems, Inc.
 7. Oldcastle Enclosure Solutions.
 8. O-Z/Gedney; a brand of Emerson Industrial Automation.
 9. Quazite: Hubbell Power Systems, Inc.
 10. RACO; Hubbell.
 11. Spring City Electrical Manufacturing Company.
 12. Thomas & Betts Corporation; A Member of the ABB Group.
 13. Wiremold / Legrand.
- C. General Requirements for Boxes, Enclosures, and Cabinets:
1. Comply with TIA-569-D.
 2. Boxes, enclosures, and cabinets installed in wet locations shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for use in wet locations.
 3. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
 4. Device Box Dimensions: 4 -11/16 inches by 2-1/8 inches deep with single mud ring.
 5. Gangable boxes are allowed.
- D. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- E. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 , 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:
 - a. Material: Plastic.
 - b. Finished inside with radio-frequency-resistant paint.

3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

F. Cabinets:

1. NEMA 250, Type 1 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.

2.6 POLYMER-CONCRETE HANDHOLES

- A. Description: Molded of sand and aggregate; bound together with polymer resin; and reinforced with steel, fiberglass, or a combination of the two.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Armorcast Products Company.
 2. NewBasis.
 3. Oldcastle Enclosure Solutions.
 4. Oldcastle Precast, Inc.
 5. Quazite: Hubbell Power Systems, Inc.
- C. General Requirements for Polymer Concrete Handholes:
1. Boxes and handholes for use in underground systems shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
 2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
 3. Comply with TIA-569-D and SCTE 77.
- D. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
- E. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
1. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 2. Cover Legend: Molded lettering, "COMMUNICATIONS".

PART 3 - EXECUTION

3.1 PATHWAY APPLICATION

- A. Outdoors: Apply pathway products as specified below unless otherwise indicated:
1. Exposed Conduit: GRC IMC RNC, Type EPC-40-PVC.
 2. Concealed Conduit, Aboveground: GRC.
 3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried.

4. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply pathway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed, Not Subject to Severe Physical Damage: EMT.
3. Exposed and Subject to Severe Physical Damage: GRC. Pathway locations include the following:
 - a. Loading dock.
 - b. Baggage handling areas
 - c. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - d. Mechanical rooms.
4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
5. Damp or Wet Locations: GRC.
6. Pathways for Optical-Fiber or Communications Cable in Spaces Used for Environmental Air: EMT.
7. Pathways for Optical-Fiber or Communications-Cable Risers in Vertical Shafts: EMT.
8. Pathways for Concealed General-Purpose Distribution of Optical-Fiber or Communications Cable: EMT.
9. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel units in institutional and commercial kitchens and damp or wet locations.

C. Minimum Pathway Size: 3/4-inch trade size for copper and aluminum cables, and 1 inch for optical-fiber cables.

D. Pathway Fittings: Compatible with pathways 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 compression, steel fittings. Comply with NEMA FB 2.10.

E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

F. Install surface pathways only where indicated on Drawings.

G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.2 INSTALLATION

A. Comply with the following standards for installation requirements except where requirements on Drawings or in this Section are stricter:

1. NECA 1.
2. NECA/BICSI 568.
3. TIA-569-D.
4. NECA 101
5. NECA 102.
6. NECA 105.

- B. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.
- C. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- D. Comply with requirements in Section 270529 "Hangers and Supports for Communications Systems" for hangers and supports.
- E. Comply with requirements in Section 270544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling" for sleeves and sleeve seals for communications.
- F. Keep pathways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.
- G. Complete pathway installation before starting conductor installation.
- H. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- I. Install no more than the equivalent of two 90-degree bends in any pathway run. Support within 12 inches of changes in direction. Utilize long radius ells for all optical-fiber cables.
- J. Conceal rigid conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- K. Support conduit within 12 inches of enclosures to which attached.
- L. Pathways Embedded in Slabs:
 - 1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure pathways to reinforcement at maximum 10-foot intervals.
 - 2. Arrange pathways to cross building expansion joints at right angles with expansion fittings. Comply with requirements for expansion joints specified in this article.
 - 3. Arrange pathways to keep a minimum of 2 inches of concrete cover in all directions.
 - 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
 - 5. Change from nonmetallic conduit and fittings to GRC and fittings before rising above floor.
- M. Stub-ups to Above Recessed Ceilings:
 - 1. Use EMT, IMC, or RMC for pathways.
 - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- N. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.
- O. Coat field-cut threads on PVC-coated pathway with a corrosion-preventing conductive compound prior to assembly.
- P. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.

- Q. 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.
- R. Cut conduit perpendicular to the length. For conduits of 2-inch trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.
- S. Install pull wires in empty pathways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Secure pull wire, so it cannot fall into conduit. Cap pathways designated as spare alongside pathways in use.
- T. Install pathway-sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed pathways, 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 pathway-sealing fittings according to NFPA 70.
- U. Install devices to seal pathway 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 pathways at the following points:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 2. Where an underground service pathway enters a building or structure.
 3. Where otherwise required by NFPA 70.
- V. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.
- W. Expansion-Joint Fittings:
1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F, and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC that is located where environmental temperature change may exceed 100 deg F, and that has straight-run length that exceeds 100 feet.
 2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
 - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
 - d. Attics: 135 deg F temperature change.
 3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F 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 of temperature change for metal conduits.
 4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
 5. 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.
- X. Hooks:

1. Size to allow a minimum of 50 percent future capacity without exceeding design capacity limits.
 2. Shall be supported by dedicated support wires. Do not use ceiling grid support wire or support rods.
 3. Hook spacing shall allow no more than **6 inches** of slack. The lowest point of the cables shall be no less than **6 inches** adjacent to ceilings, mechanical ductwork and fittings, luminaires, power conduits, power and telecommunications outlets, and other electrical and communications equipment.
 4. Space hooks no more than **5 feet** o.c.
 5. Provide a hook at each change in direction.
- Y. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
- Z. 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 surface to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
- AA. Horizontally separate boxes mounted on opposite sides of walls, so they are not in the same vertical channel.
- BB. 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.
- CC. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- DD. Set metal floor boxes level and flush with finished floor surface.
- EE. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 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 Section 312000 "Earth Moving" for pipe of less than 6 inches in nominal diameter.
 2. Install backfill as specified in Section 312000 "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 of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."
 4. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete around conduit for a minimum of 12 inches on each side of the coupling.
 - b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a

minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.

5. Underground Warning Tape: Comply with requirements in Section 270553 "Identification for Communications Systems."

3.4 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 sieve to No. 4 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 above finished grade.

3.5 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.6 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage or 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 270528.22

SECTION 284621.11

ADDRESSABLE FIRE-ALARM 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. Addressable fire-alarm system.
2. Fire-alarm control unit (FACU).
3. Manual fire-alarm boxes.
4. System smoke detectors.
5. Duct smoke detectors.
6. Carbon monoxide detectors.
7. Heat detectors.
8. Fire-alarm notification appliances.
9. Fire-alarm remote annunciators.
10. Fire-alarm addressable interface devices.

B. Related Requirements:

1. Section 260519 "Low-Voltage Electrical Power Conductors and Cables" or Section 260523 "Control Voltage Electrical Power Cables" for cables and conductors for fire-alarm systems.

1.3 DEFINITIONS

- A. DACT: Digital alarm communicator transmitter.
- B. EMT: Electrical metallic tubing.
- C. FACU: Fire-alarm control unit.
- D. High-Performance Building: A building that integrates and optimizes on a life-cycle basis all major high-performance attributes, including energy conservation, environment, safety, security, durability, accessibility, cost-benefit, productivity, sustainability, functionality, and operational considerations.
- E. Mode: The terms "Active Mode," "Off Mode," and "Standby Mode" are used as defined in the 2007 Energy Independence and Security Act (EISA).
- F. NICET: National Institute for Certification in Engineering Technologies.

- G. PC: Personal computer.
- H. Voltage Class: For specified circuits and equipment, voltage classes are defined as follows:
 - 1. Control Voltage: Listed and labeled for use in remote-control, signaling, and power-limited circuits supplied by a Class 2 or Class 3 power supply having rated output not greater than 150 V and 5 A, allowing use of alternate wiring methods complying with NFPA 70, Article 725.
 - 2. Low Voltage: Listed and labeled for use in circuits supplied by a Class 1 or other power supply having rated output not greater than 1000 V, requiring use of wiring methods complying with NFPA 70, Article 300, Part I.

1.4 ACTION SUBMITTALS

- A. Approved Permit Submittal: Submittals must be approved by authorities having jurisdiction prior to submitting them to Architect.
- B. Product Data: For each type of product, including furnished options and accessories.
 - 1. Include construction details, material descriptions, dimensions, profiles, and finishes.
 - 2. Include rated capacities, operating characteristics, and electrical characteristics.
- C. Shop Drawings: For fire-alarm system.
 - 1. Comply with recommendations and requirements in "Documentation" section of "Fundamentals" chapter in NFPA 72.
 - 2. Include plans, elevations, sections, and details, including details of attachments to other Work.
 - 3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
 - 4. Annunciator panel details as required by authorities having jurisdiction.
 - 5. Detail assembly and support requirements.
 - 6. Include voltage drop calculations for notification-appliance circuits.
 - 7. Include battery-size calculations.
 - 8. Include input/output matrix.
 - 9. Include written statement from manufacturer that equipment and components have been tested as a system and comply with requirements in this Section and in NFPA 72.
 - 10. Include performance parameters and installation details for each detector.
 - 11. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
 - 12. Provide program report showing that air-sampling detector pipe layout balances pneumatically within airflow range of air-sampling detector.
 - 13. Provide control wiring diagrams for fire-alarm interface to HVAC; coordinate location of duct smoke detectors and access to them.
 - a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
 - b. Show field wiring[and equipment] required for HVAC unit shutdown on alarm[and override by firefighters' smoke-evacuation system].
 - c. Locate detectors in accordance with manufacturer's written instructions.
 - d. Show air-sampling detector pipe routing.

14. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.

D. Delegated Design Submittal: For notification appliances and smoke and heat detectors, in addition to submittals listed above, indicate compliance with performance requirements and design criteria, including analysis data signed and sealed by qualified professional engineer responsible for their preparation.

1. Drawings showing location of each notification appliance and smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of device.
2. Design Calculations: Calculate requirements for selecting spacing and sensitivity of detection, complying with NFPA 72. Calculate spacing and intensities for strobe signals and sound-pressure levels for audible appliances.
3. Indicate audible appliances required to produce square wave signal per NFPA 72.

1.5 INFORMATIONAL SUBMITTALS

A. Certificates:

1. Seismic Performance Certificates: For FACU, accessories, and components, from manufacturer. Include the following information:
 - a. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - b. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - c. Detailed description of equipment anchorage devices on which certification is based and their installation requirements.

B. Qualification Statements: For Installer.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following[and deliver copies to authorities having jurisdiction]:
 - a. Comply with "Records" section of "Inspection, Testing and Maintenance" chapter in NFPA 72.
 - b. Provide "Fire-Alarm and Emergency Communications System Record of Completion Documents" in accordance with "Completion Documents" Article in "Documentation" section of "Fundamentals" chapter in NFPA 72.
 - c. Complete wiring diagrams showing connections between devices and equipment. Each conductor must be numbered at every junction point with indication of origination and termination points.
 - d. Riser diagram.
 - e. Device addresses.
 - f. Air-sampling system sample port locations and modeling program report showing layout meets performance criteria.
 - g. Record copy of site-specific software.

- h. Provide "Inspection and Testing Form" in accordance with "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:
 - 1) Equipment tested.
 - 2) Frequency of testing of installed components.
 - 3) Frequency of inspection of installed components.
 - 4) Requirements and recommendations related to results of maintenance.
 - 5) Manufacturer's user training manuals.
- i. Manufacturer's required maintenance related to system warranty requirements.
- j. Abbreviated operating instructions for mounting at FACU and each annunciator unit.

B. Software and Firmware Operational Documentation:

- 1. Software operating and upgrade manuals.
- 2. Program Software Backup: On USB media.
- 3. Device address list.
- 4. Printout of software application and graphic screens.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Material: Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

- 1. Lamps for Remote Indicating Lamp Units: Quantity equal to [10] <Insert number> percent of amount installed, but no fewer than one unit.
- 2. Smoke Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than one unit of each type.
- 3. Detector Bases: Quantity equal to two percent of amount of each type installed, but no fewer than one unit of each type.
- 4. Keys and Tools: One extra set for access to locked or tamperproofed components.

1.8 QUALITY ASSURANCE

A. Installer Qualifications:

- 1. Personnel must be trained and certified by manufacturer for installation of units required for this Project.
- 2. Installation must be by personnel certified by NICET as fire-alarm Level IV technician.
- 3. Obtain certification by NRTL in accordance with NFPA 72.
- 4. Licensed or certified by authorities having jurisdiction.

1.9 FIELD CONDITIONS

A. Seismic Conditions: Unless otherwise indicated on Contract Documents, specified Work in this Section must withstand the seismic hazard design loads determined in accordance with [ASCE/SEI 7] <Insert requirement> for installed elevation above or below grade.

- 1. The term "withstand" means "unit must remain in place without separation of parts from unit when subjected to specified seismic design loads[and unit must be fully operational after seismic event]."

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail because of defects in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ADDRESSABLE FIRE-ALARM SYSTEM

- A. Description:

1. Noncoded, UL-certified addressable system, with multiplexed signal transmission and horn-and-strobe notification for evacuation.

- B. Performance Criteria:

1. Regulatory Requirements:

- a. Fire-Alarm Components, Devices, and Accessories: Listed and labeled by a NRTL in accordance with NFPA 70 for use with selected fire-alarm system and marked for intended location and application.

2. General Characteristics:

- a. Automatic sensitivity control of certain smoke detectors.
- b. Fire-alarm signal initiation must be by one or more of the following devices and systems:

- 1) Manual stations.
- 2) Heat detectors.
- 3) Smoke detectors.
- 4) Duct smoke detectors.
- 5) Carbon monoxide detectors.
- 6) Automatic sprinkler system water flow.
- 7) Preaction system.
- 8) Fire-extinguishing system operation.

- c. Fire-alarm signal must initiate the following actions:

- 1) Continuously operate alarm notification appliances.
- 2) Identify alarm and specific initiating device at FACU and remote annunciators.
- 3) Transmit alarm signal to remote alarm receiving station.
- 4) Unlock electric door locks in designated egress paths.
- 5) Release fire and smoke doors held open by magnetic door holders.
- 6) Activate voice/alarm communication system.
- 7) Switch HVAC equipment controls to fire-alarm mode.
- 8) Close smoke dampers in air ducts of designated air-conditioning duct systems.
- 9) Activate preaction system.

- 10) Recall elevators to primary or alternate recall floors.
- 11) Activate elevator power shunt trip.
- 12) Activate emergency shutoffs for gas and fuel supplies.
- 13) Record events in system memory.
- 14) Record events by system printer.
- 15) Indicate device in alarm on graphic annunciator.

d. Supervisory signal initiation must be by one or more of the following devices and actions:

- 1) Valve supervisory switch.
- 2) High- or low-air-pressure switch of dry-pipe or preaction sprinkler system.
- 3) Elevator shunt-trip supervision.
- 4) Independent fire-detection and -suppression systems.
- 5) Zones or individual devices have been disabled.

e. System trouble signal initiation must be by one or more of the following devices and actions:

- 1) Open circuits, shorts, and grounds in designated circuits.
- 2) Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
- 3) Loss of communication with addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
- 4) Loss of primary power at FACU.
- 5) Ground or single break in internal circuits of FACU.
- 6) Abnormal ac voltage at FACU.
- 7) Break in standby battery circuitry.
- 8) Failure of battery charging.
- 9) Abnormal position of switch at FACU or annunciator.

f. System Supervisory Signal Actions:

- 1) Initiate notification appliances.
- 2) Identify specific device initiating event at FACU and remote annunciators.
- 3) Record event on system printer.
- 4) After time delay of 200 seconds, transmit trouble or supervisory signal to remote alarm receiving station.
- 5) Transmit system status to building management system.

2.2 FIRE-ALARM CONTROL UNIT (FACU)

A. Manufacturers and Installers: Subject to compliance with requirements, provide products by one of the following:

1. Bosch Security Systems, Inc.
2. Honeywell International (Honeywell Gamewell-FCI).
3. Honeywell International (Notifier).
4. Honeywell International (Silent Knight).
5. Tyco International (Johnson Controls - SimplexGrinnell).
6. Potter.
7. Edwards System Technology (EST).

B. Description: Field-programmable, microprocessor-based, modular, power-limited design with

electronic modules.

C. Performance Criteria:

1. Regulatory Requirements: Comply with NFPA 72 and UL 864.
2. General Characteristics:
 - a. System software and programs must be held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining information through failure of primary and secondary power supplies.
 - b. Include real-time clock for time annotation of events on event recorder and printer.
 - c. Provide communication between FACU and remote circuit interface panels, annunciators, and displays.
 - d. FACU must be listed for connection to central-station signaling system service.
 - e. Provide nonvolatile memory for system database, logic, and operating system and event history. System must require no manual input to initialize in the event of complete power down condition. FACU must provide minimum 500-event history log.
 - f. Addressable Initiation Device Circuits: FACU must indicate which communication zones have been silenced and must provide selective silencing of alarm notification appliance by building communication zone.
 - 1) Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: FACU must be listed for releasing service.
 - g. Alphanumeric Display and System Controls: Arranged for interface between human operator at FACU and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and programming and control menu.
 - 1) Annunciator and Display: LCD, two line(s) of 40 characters, minimum.
 - 2) Keypad: Arranged to permit entry and execution of programming, display, and control commands[and to indicate control commands to be entered into system for control of smoke-detector sensitivity and other parameters].
 - h. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:
 - 1) Pathway Class Designations: NFPA 72, Class A .
 - 2) Pathway Survivability: Level 1.
 - 3) Confirm quantity of addressable devices on each signaling-line circuit with system supplier.
 - i. Serial Interfaces:
 - 1) One RS 485 port for remote annunciators, Ethernet module, or multi-interface module (printer port).
 - 2) One USB port for PC configuration.
 - j. Smoke-Alarm Verification:
 - 1) Initiate audible and visible indication of "alarm-verification" signal at FACU.
 - 2) Activate approved "alarm-verification" sequence at FACU and detector.
 - 3) Record events by system printer.
 - 4) Sound general alarm if alarm is verified.
 - 5) Cancel FACU indication and system reset if alarm is not verified.

k. Notification-Appliance Circuit:

- 1) Audible appliances must sound in three-pulse temporal pattern, as defined in NFPA 72.
- 2) Where notification appliances provide signals to sleeping areas, alarm signal must be 520 Hz square wave with intensity 15 dB above average ambient sound level or 5 dB above maximum sound level, or at least 75 dB(A-weighted), whichever is greater, measured at pillow.
- 3) Visual alarm appliances must flash in synchronization where multiple appliances are in same field of view, as defined in NFPA 72.

l. Elevator Recall: Initiate by one of the following alarm-initiating devices:

- 1) Elevator lobby detectors except lobby detector on designated floor.
- 2) Smoke detectors in elevator machine room.
- 3) Smoke detectors in elevator hoistway.

m. Elevator controller must be programmed to move cars to alternate recall floor if lobby detectors located on designated recall floors are activated.

n. Water-flow alarm connected to sprinkler in elevator shaft and elevator machine room must shut down elevators associated with location without time delay.

- 1) Water-flow switch associated with sprinkler in elevator pit may have delay to allow elevators to move to designated floor.

o. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke-barrier walls must [not]be connected to fire-alarm system.

p. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble) and date and time of occurrence. Differentiate alarm signals from other printed indications. Also, print system reset event, including same information for device, location, date, and time. Commands initiate printing of list of alarm, supervisory, and trouble conditions in system and historical log of events.

q. Primary Power: 24 V(dc) obtained from 120 V(ac) service and power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, and supervisory signals must be powered by 24 V(dc) source.

r. Alarm current draw of entire fire-alarm system must not exceed 80 percent of power-supply module rating.

s. Secondary Power: 24 V(dc) supply system with batteries, automatic battery charger, and automatic transfer switch.

t. Batteries: Sealed lead calcium.

D. Accessories:

1. Instructions: Computer printout or typewritten instruction card mounted behind plastic or glass cover in stainless steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe functional operation of system under normal, alarm, and trouble conditions.
2. Preaction System Functionality:

- a. Initiate Presignal Alarm: This function must cause audible and visual alarm and indication to be provided at FACU. Activation of initiation device connected as part of preaction system must be annunciated at FACU only, without activation of general evacuation alarm.

2.3 MANUAL FIRE-ALARM BOXES

- A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes must be finished in red with molded, raised-letter operating instructions in contrasting color; must show visible indication of operation; and must be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
1. Double-action mechanism requiring two actions to initiate alarm, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to FACU.
 2. Station Reset: Key- or wrench-operated switch.
 3. Indoor Protective Shield: Factory-fabricated, clear plastic enclosure hinged at top to permit lifting for access to initiate alarm. Lifting cover actuates integral battery-powered audible horn intended to discourage false-alarm operation.
 4. Weatherproof Protective Shield: Factory-fabricated, clear plastic enclosure hinged at top to permit lifting for access to initiate alarm.

2.4 SYSTEM SMOKE DETECTORS

- A. Photoelectric Smoke Detectors:
1. Performance Criteria:
 - a. Regulatory Requirements:
 - 1) NFPA 72.
 - 2) UL 268.
 - b. General Characteristics:
 - 1) Detectors must be two-wire type.
 - 2) Base Mounting: Detector and associated electronic components must be mounted in twist-lock module that connects to fixed base. Provide terminals in fixed base for connection to building wiring.
 - 3) Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
 - 4) Integral Visual-Indicating Light: LED type, indicating detector has operated[and power-on status].
 - 5) Detector address must be accessible from FACU and must be able to identify detector's location within system and its sensitivity setting.
 - 6) Operator at FACU, having designated access level, must be able to manually access the following for each detector:
 - a) Primary status.
 - b) Device type.
 - c) Present average value.
 - d) Present sensitivity selected.
 - e) Sensor range (normal, dirty, etc.).
 - 7) Color: [White] <Insert color>.
 - 8) Remote Control: Unless otherwise indicated, detectors must be digital-addressable type, individually monitored at FACU for calibration, sensitivity, and alarm condition[and individually adjustable for sensitivity by FACU].

- 9) Rate-of-rise temperature characteristic of combination smoke- and heat-detection units must be selectable at FACU for 15 or 20 deg F per minute.
- 10) Fixed-temperature sensing characteristic of combination smoke- and heat-detection units must be independent of rate-of-rise sensing and must be settable at FACU to operate at 135 or 155 deg F.
- 11) Multiple levels of detection sensitivity for each sensor.
- 12) Sensitivity levels based on time of day.

2.5 DUCT SMOKE DETECTORS

A. Description: Photoelectric-type, duct-mounted smoke detector.

B. Performance Criteria:

1. Regulatory Requirements:

- a. NFPA 72.
- b. UL 268A.

2. General Characteristics:

- a. Detectors must be two-wire type.
- b. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.
- c. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
- d. Integral Visual-Indicating Light: LED type, indicating detector has operated[and power-on status].
- e. Detector address must be accessible from FACU and must be able to identify detector's location within system and its sensitivity setting.
- f. Operator at FACU, having designated access level, must be able to manually access the following for each detector:
 - 1) Primary status.
 - 2) Device type.
 - 3) Present average value.
 - 4) Present sensitivity selected.
 - 5) Sensor range (normal, dirty, etc.).
- g. Each sensor must have multiple levels of detection sensitivity.
- h. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
- i. Relay Fan Shutdown: Fully programmable relay rated to interrupt fan motor-control circuit.

2.6 CARBON MONOXIDE DETECTORS

A. Description: Carbon monoxide detector listed for connection to fire-alarm system.

B. Performance Criteria:

1. Regulatory Requirements:

- a. NFPA 72
- b. NFPA 720.
- c. UL 2075.

2. General Characteristics:

- a. Mounting: Adapter plate for outlet box mounting.
- b. Testable by introducing test carbon monoxide into sensing cell.
- c. Detector must provide alarm contacts and trouble contacts.
- d. Detector must send trouble alarm when nearing end-of-life, power supply problems, or internal faults.
- e. Locate, mount, and wire in accordance with manufacturer's written instructions.
- f. Provide means for addressable connection to fire-alarm system.
- g. Test button simulates alarm condition.

2.7 HEAT DETECTORS

A. Combination-Type Heat Detectors:

1. Performance Criteria:

a. Regulatory Requirements:

- 1) NFPA 72.

b. General Characteristics:

- 1) Temperature sensors must test for and communicate sensitivity range of device.
 - 2) Actuated by fixed temperature of [135 deg F] <Insert temperature> or rate of rise that exceeds [15 deg F] <Insert temperature> per minute unless otherwise indicated.
 - 3) Mounting: Twist-lock base interchangeable with smoke-detector bases.
 - 4) Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.
 - 5) Detector must have functional humidity range of 10 to 90 percent relative humidity.
- a) Color: White.

2.8 FIRE-ALARM NOTIFICATION APPLIANCES

A. Fire-Alarm Audible Notification Appliances:

- 1. Description: Horns, bells, or other notification devices that cannot output voice messages.
- 2. Performance Criteria:
 - a. Regulatory Requirements:
 - 1) NFPA 72.
 - b. General Characteristics:

- 1) Individually addressed, connected to signaling-line circuit, equipped for mounting as indicated, and with screw terminals for system connections.
- 2) Connected to notification-appliance signal circuits, zoned as indicated, equipped for mounting as indicated, and with screw terminals for system connections.
- 3) Horns: Electric-vibrating-polarized type, 24 V(dc); with provision for housing operating mechanism behind grille. Comply with UL 464. Horns must produce sound-pressure level of 90 dB(A-weighted), measured 10 ft. from horn, using coded signal prescribed in UL 464 test protocol.
- 4) Combination Devices: Factory-integrated audible and visible devices in single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.

B. Fire-Alarm Visible Notification Appliances:

1. Performance Criteria:

a. Regulatory Requirements:

- 1) NFPA 72.
- 2) UL 1971.

b. General Characteristics:

- 1) Rated Light Output:
 - a) 15/30/75/110/177 cd, selectable in field.
- 2) Clear or nominal white polycarbonate lens mounted on aluminum faceplate.
- 3) Mounting: Wall mounted unless otherwise indicated.
- 4) For units with guards to prevent physical damage, light output ratings must be determined with guards in place.
- 5) Flashing must be in temporal pattern, synchronized with other units.
- 6) Strobe Leads: Factory connected to screw terminals.
- 7) Mounting Faceplate: Factory finished, red.

2.9 FIRE-ALARM REMOTE ANNUNCIATORS

A. Performance Criteria:

1. Regulatory Requirements:

- a. NFPA 72.

2. General Characteristics:

- a. Annunciator functions must match those of FACU for alarm, supervisory, and trouble indications. Manual switching functions must match those of FACU, including acknowledging, silencing, resetting, and testing.
 - 1) Mounting: Flush cabinet, NEMA 250, Type 1.
- b. Display Type and Functional Performance: Alphanumeric display and LED indicating lights must match those of FACU. Provide controls to acknowledge,

silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.10 FIRE-ALARM ADDRESSABLE INTERFACE DEVICES

A. Performance Criteria:

1. Regulatory Requirements:

- a. NFPA 72.

2. General Characteristics:

- a. Include address-setting means on module.
- b. Store internal identifying code for control panel use to identify module type.
- c. Listed for controlling HVAC fan motor controllers.
- d. Monitor Module: Microelectronic module providing system address for alarm-initiating devices for wired applications with normally open contacts.
- e. Integral Relay: Capable of providing direct signal to elevator controller to initiate elevator recall and to circuit-breaker shunt trip for power shutdown.
 - 1) Allow control panel to switch relay contacts on command.
 - 2) Have minimum of two normally open and two normally closed contacts available for field wiring.
- f. Control Module:
 - 1) Operate notification devices.
 - 2) Operate solenoids for use in sprinkler service.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for 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 and wiring are installed, before installation begins.
- B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Protection of In-Place Conditions: Protect devices during construction unless devices are placed in service to protect facility during construction.

3.3 INSTALLATION OF EQUIPMENT

- A. Comply with NECA 305, NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."
 - 1. Devices placed in service before other trades have completed cleanup must be replaced.
 - 2. Devices installed, but not yet placed, in service must be protected from construction dust, debris, dirt, moisture, and damage in accordance with manufacturer's written storage instructions.
- B. Install wall-mounted equipment, with tops of cabinets not more than 78 inch above finished floor.
 - 1. Comply with requirements for seismic-restraint devices specified in Section 270548.16 "Seismic Controls for Communications Systems."
- C. Manual Fire-Alarm Boxes:
 - 1. Install manual fire-alarm box in normal path of egress within 60 inch of exit doorway.
 - 2. Mount manual fire-alarm box on background of contrasting color.
 - 3. Operable part of manual fire-alarm box must be between 42 and 48 inch above floor level. Devices must be mounted at same height unless otherwise indicated.
- D. Smoke- and Heat-Detector Spacing:
 - 1. Comply with "Smoke-Sensing Fire Detectors" section in "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.
 - 2. Comply with "Heat-Sensing Fire Detectors" section in "Initiating Devices" chapter in NFPA 72, for heat-detector spacing.
 - 3. Smooth ceiling spacing must not exceed 30 ft..
 - 4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas must be determined in accordance with Annex A or Annex B in NFPA 72.
 - 5. HVAC: Locate detectors not closer than 36 inch from air-supply diffuser or return-air opening.
 - 6. Lighting Fixtures: Locate detectors not closer than 12 inch from lighting fixture and not directly above pendant mounted or indirect lighting.
- E. Install cover on each smoke detector that is not placed in service during construction. Cover must remain in place except during system testing. Remove cover prior to system turnover.
- F. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend full width of duct. Tubes more than 36 inch long must be supported at both ends.
 - 1. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to system turnover.
- G. Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location. Do not install smoke detectors in sprinklered elevator shafts.
- H. Remote Status and Alarm Indicators: Install in visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.
- I. Audible Alarm-Indicating Devices: Install not less than 6 inch below ceiling. Install bells and

horns on flush-mounted back boxes with device-operating mechanism concealed behind grille. Install devices at same height unless otherwise indicated.

- J. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inch below ceiling. Install devices at same height unless otherwise indicated.
- K. Device Location-Indicating Lights: Locate in public space near device they monitor.

3.4 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 must be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."
 - 2. Nameplate must be laminated acrylic or melamine plastic signs with black background and engraved white letters at least 1/2 inch high.

3.5 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."
- C. Install nameplate for each control connection, indicating field control panel designation and I/O control designation feeding connection.

3.6 PATHWAYS

- A. Pathways above recessed ceilings and in inaccessible locations may be routed exposed.
 - 1. Exposed pathways located less than 96 inch above floor must be installed in EMT.
- B. Pathways must be installed in EMT.
- C. Exposed EMT must be painted red enamel.

3.7 CONNECTIONS

- A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Section 087100 "Door Hardware." Connect

hardware and devices to fire-alarm system.

1. Verify that hardware and devices are listed for use with installed fire-alarm system before making connections.

- B. Make addressable connections with supervised interface device to the following devices and systems. Install interface device less than 36 inch from device controlled. Make addressable confirmation connection when such feedback is available at device or system being controlled.

1. Alarm-initiating connection to smoke-control system (smoke management) at firefighters' smoke-control system panel.
2. Alarm-initiating connection to stairwell and elevator-shaft pressurization systems.
3. Smoke dampers in air ducts of designated HVAC duct systems.
4. Magnetically held-open doors.
5. Electronically locked doors and access gates.
6. Alarm-initiating connection to elevator recall system and components.
7. Alarm-initiating connection to activate emergency lighting control.
8. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
9. Supervisory connections at valve supervisory switches.
10. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
11. Supervisory connections at elevator shunt-trip breaker.
12. Data communication circuits for connection to building management system.
13. Data communication circuits for connection to mass notification system.
14. Supervisory connections at fire-extinguisher locations.
15. Supervisory connections at fire-pump power failure including dead-phase or phase-reversal condition.
16. Supervisory connections at fire-pump engine control panel.

3.8 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."
- B. Install framed instructions in location visible from FACU.

3.9 GROUNDING

- A. Ground FACU and associated circuits in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Ground shielded cables at control panel location only. Insulate shield at device location.

3.10 FIELD QUALITY CONTROL

- A. Field tests must be witnessed by authorities having jurisdiction.
- B. Administrant for Tests and Inspections:
1. Owner will engage qualified testing agency to administer and perform tests and inspections.
 2. Engage qualified testing agency to administer and perform tests and inspections.
 3. Engage factory-authorized service representative to administer and perform tests and

- inspections on components, assemblies, and equipment installations, including connections.
 - 4. Administer and perform tests and inspections with assistance of factory-authorized service representative.
- C. Tests and Inspections:
- 1. Visual Inspection: Conduct visual inspection prior to testing.
 - a. Inspection must be based on completed record Drawings and system documentation that is required by "Completion Documents, Preparation" table in "Documentation" section of "Fundamentals" chapter in NFPA 72.
 - b. Comply with "Visual Inspection Frequencies" table in "Inspection" section of "Inspection, Testing and Maintenance" chapter in NFPA 72; retain "Initial/Reacceptance" column and list only installed components.
 - 2. System Testing: Comply with "Test Methods" table in "Testing" section of "Inspection, Testing and Maintenance" chapter in NFPA 72.
 - 3. Test audible appliances for public operating mode in accordance with manufacturer's written instructions. Perform test using portable sound-level meter complying with Type 2 requirements in ASA S1.4 Part 1/IEC 61672-1.
 - 4. Test audible appliances for private operating mode in accordance with manufacturer's written instructions.
 - 5. Test visible appliances for public operating mode in accordance with manufacturer's written instructions.
 - 6. Factory-authorized service representative must prepare "Fire Alarm System Record of Completion" in "Documentation" section of "Fundamentals" chapter in NFPA 72 and "Inspection and Testing Form" in "Records" section of "Inspection, Testing and Maintenance" chapter in NFPA 72.
- D. Reacceptance Testing: Perform reacceptance testing to verify proper operation of added or replaced devices and appliances.
- E. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.
- G. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.
- H. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.
- 3.11 DEMONSTRATION
- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system. Provide video recording of training to Owner.
- 3.12 MAINTENANCE
- A. Maintenance Service: Beginning at Substantial Completion, maintenance service must include 12 months' full maintenance by skilled employees of manufacturer's designated service

organization. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Parts and supplies must be manufacturer's authorized replacement parts and supplies.

1. Include visual inspections in accordance with "Visual Inspection Frequencies" table in "Testing" paragraph of "Inspection, Testing and Maintenance" chapter in NFPA 72.
2. Perform tests in "Test Methods" table in "Testing" paragraph of "Inspection, Testing and Maintenance" chapter in NFPA 72.
3. Perform tests per "Testing Frequencies" table in "Testing" paragraph of "Inspection, Testing and Maintenance" chapter in NFPA 72.

3.13 SOFTWARE SERVICE AGREEMENT

- A. Comply with UL 864.
- B. Technical Support: Beginning at Substantial Completion, service agreement must include software support for two years.
- C. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within [two] <Insert number> years from date of Substantial Completion. Upgrading software must include operating system and new or revised licenses for using software.
 1. Upgrade Notice: At least 30 days to allow Owner to schedule access to system and to upgrade computer equipment if necessary.

END OF SECTION 284621.11

SECTION 31 20 00

EARTHWORK

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes the following:
 - 1. Rough grading of subgrades for slabs-on-grade, walks, pavements, lawns, and landscape areas.
 - 2. Excavating and backfilling for buildings, site structures and screen walls.
 - 3. Preparation and compaction of building pad subbase.
 - 4. Subbase course for concrete walks and pavements.
 - 5. Base course for asphalt paving.
 - 6. Subsurface drainage backfill for walls and trenches.
 - 7. Excavating and backfilling trenches under building slab-on-grades.
 - 8. Excavating and backfilling trenches for buried water and electrical utilities.
 - 9. Excavating and backfilling trenches for buried drainage devices.
- B. Related Sections include the following:
 - 1. Section 03 30 00 for "Cast-in-Place Concrete" for granular course under building slabs.

1.02 RELATED DOCUMENTS

- A. Refer to soil and pavement recommendations of the Project Soils Report listed in Document 00880 "Soils Investigation Data".

1.03 DEFINITIONS

- A. Backfill: Soil materials 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. Excavation: Removal of material encountered above subgrade elevations and subsequent reuse or disposal of excess materials removed.
 - 1. Additional Excavation: Excavation below subgrade elevations as directed by Engineer. Additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
 - 2. Bulk Excavation: Excavations more than 10 feet in width and pits more than 30 feet in either length or width.
 - 3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated dimensions without direction by Engineer.
- C. Fill: Soil materials used to raise existing grades. The materials used for fill shall contain no vegetation, ash, wood, man-made material, organic soils or any material which may decay or otherwise cause settlement.
- D. Import Select Fill: Suitable material shall be supplied with a plasticity index less than 20 from approved borrow sources. Materials imported to the project site shall be certified for compliance with the Soils Report recommendations.

- E. 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.
- F. Subbase Course: Layer placed between the subgrade and base course of asphalt paving, or layer placed between the subgrade and concrete pavement.
- G. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.
- H. Utilities: Includes underground pipes, conduits, ducts, and cables, as well as underground services under buildings.
- I. Engineer: Representative of the Geotechnical Testing Agency engaged by the Owner.

1.04 QUALITY ASSURANCE

- A. Codes and Standards: For work performed within the public right-of-way, comply with, County standard specifications, City of Salt Lake regulations, latest edition, if more stringent than herein specified.
- B. Geotechnical Testing Agency Qualifications: Owner will engage soil testing and inspection service for quality control testing during earthwork operations.
- C. Imported Fill: Provide an Environmental Report, in format acceptable to Owner, for all borrowed or imported soil material proposed to be used in the Work. Provide Report for Owner's review prior to delivery of fill materials to Project.

1.05 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Owner and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Owner not less than ten days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Owner's written permission.
 - 3. Contact utility-locator service for area where Project is located before excavating.
 - 4. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult utility owner immediately for directions. Cooperate with owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility company.
- B. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.
- C. Site Conditions: Data indicated on subsurface conditions are not intended as representations or warranties of accuracy or continuity between soil borings. It is expressly understood that Owner will not be responsible for interpretations or conclusions drawn there from by Contractor. Data are made available for convenience of Contractor.
 - 1. Additional test borings and other exploratory operations may be made by Contractor at no cost to Owner.
- D. Protect structures, utilities, sidewalks, pavements and other facilities from damage caused by settlement, lateral movement, undermining, washout and other hazards created by earthwork operations.
 - 1. Barricade open excavations occurring as part of this work and post with warning lights.
 - 2. Operate warning lights as required by authorities having jurisdiction.

- E. Use of Explosives: The use of explosives is not permitted.

PART 2 - PRODUCTS

2.01 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from on-site excavations.
- B. Satisfactory Soils: ASTM D 2487 soil classification groups GW, GP, GM, SW, SP, and SM, or a combination of these group symbols; free of rock or gravel larger than 3 inches in any dimension, debris, waste, vegetation, ash, wood, organic soils or any man-made material and other deleterious matter, which may decay, shrink or otherwise cause settlement. Materials to be placed within 10' of the building areas shall be free from rock, stone or broken concrete.
- C. Import Select Fill: Suitable material shall be supplied with a plasticity index less than 20 from approved borrow sources. Materials imported to the project site shall be certified for compliance with the Soils Report recommendations.
- D. Backfill and Fill: Satisfactory soil materials.
- E. Sub-base: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.
- F. Subgrade: Existing soils which conform to the requirements of fill above on which select fill, or site fill is to be placed.
- G. Pavement Subgrade: Minimum 8 inch deep prepared subgrade of existing low-expansive on-site soils which conform to the requirements of site fills per Soils Report recommendations.
- H. On-site Sidewalk Base Course: Minimum 4 inch deep prepared subgrade of existing low -expansive granular on-site soils which conform to the requirements of site fills per Soils Report recommendations.
- I. Off-site Sidewalk Base Course: Undisturbed native soil or recompacted native soil.
- J. Pavement Base Course: See Drawings for limits of pavement types and thicknesses. Material corresponding to the soil report specifications in the following minimum depths:
 - 1. Service Duty Pavement Thickness Base Course Depth
 - a. Car parking 3 " asphalt pavement 8 inches
 - b. Firelanes 4" asphalt pavement 8 inches
 - c. Drives & Truckcourt 6" PCCP 6 inches

PART 3 - EXECUTION

3.01 GENERAL

- A. Refer to Soils Report recommendations for all earthwork.
- B. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining and other hazards created by earthwork operations.
- C. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing storm-water runoff to adjacent properties and walkways in accordance with local ordinances.

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.
 - 2. Install a dewatering system to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer required.

3.03 EXCAVATION, GENERAL

- A. Excavation: Excavations to subgrade elevations indicated is unclassified regardless of the character of surface and subsurface conditions encountered, including rock, soil materials, and obstructions.
 - 1. Remove vegetation, debris, unsatisfactory soil materials and deleterious materials from ground surface prior to placement of fills. Plow-strip, or break-up sloped surfaces steeper than 1 vertical to 4 horizontal so that fill material will bond with existing surface.
 - 2. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
- B. Stability of Excavations: Slope sides of excavations to comply with local codes and ordinances having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated.
- C. Shoring and Bracing: Provide materials for shoring and bracing, such as sheet piling, uprights, stringers and cross-braces, in good serviceable condition. Establish requirements for trench shoring and bracing to comply with local codes and authorities having jurisdiction.

3.04 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 0.10 of a foot. Extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections. See Soils Report for footing elevation alternative options.
- B. Under interior slab-on-grade, and foundation elements, scarify native subgrade surface to a minimum of twelve (12) inches, moisture-condition to optimum moisture content, and compact to required depth and percentage of maximum density. Provide 12 inches of imported fill under all ABC and concrete slabs on grade per Soils Report.
- C. 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.

3.05 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Under exterior slab-on-grade (pavements), excavate surfaces to indicated cross sections, elevations, and grades. Scarify native subgrade surface to a minimum of eight (8) inches, moisture-condition to optimum moisture content, and compact to required depth and percentage of maximum density.

3.06 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations. Verify and record pipe locations, inverts and elevations prior to backfilling of trenches.

1. Excavate trenches to uniform widths to provide a working clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit, unless otherwise indicated.
- B. Trench Bottoms: Beyond building perimeter, excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
 1. For pipes and conduit less than 6 inches in nominal diameter and flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
 2. For pipes and conduit 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe circumference. Fill depressions with sand backfill.
 3. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

3.07 APPROVAL OF SUBGRADE

- A. Notify Geotechnical Engineer when excavations have reached required subgrade.
- B. If Geotechnical Engineer determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
 1. Additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
- C. Proof roll subgrade with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof roll wet or saturated subgrades.
- D. Reconstruct subgrades damaged by rain, accumulated water, or construction activities, as directed by Geotechnical Engineer.

3.08 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 may be used when approved by Engineer.
 1. Fill unauthorized excavations as directed by Soils Engineer.

3.09 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow materials and satisfactory excavated soil materials. Stockpile soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover or water to prevent windblown dust.

3.10 BACKFILL

- A. Use only approved fill material for backfill. Place and compact backfill in excavations promptly, but not before completing the following:
 1. Construction below finish grade including, where applicable, damp-proofing, waterproofing, and perimeter insulation.
 2. Surveying locations of underground utilities for record documents.
 3. Inspecting and testing underground utilities.
 4. Removing trash and debris.
 5. Removing temporary shoring and bracing, and sheeting.

3.11 UTILITY TRENCH BACKFILL

- A. 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.
- B. Backfill trenches excavated under footings and within 24 inches of bottom of footings; fill with concrete to elevation of bottom of footings.
- C. Provide 8-inch- thick, concrete-encasement support for piping or conduit less than 30 inches below surface of roadways and driveways.
- D. Place and compact initial backfill of subbase material, free of particles larger than 1 inch, to a height of 12 inches over the utility pipe or conduit.
 - 1. Carefully compact material under pipe haunches and bring backfill evenly up on both sides and along the full length of piping or conduit to avoid displacement of utility system.
- E. Place backfill and fill materials in layers not more than 12 inches in loose depth for material compacted by heavy compaction equipment, and not more than 6 inches in loose depth for material compacted by hand-operated tampers.
- F. Place and compact final backfill of satisfactory soil material to final subgrade.
- G. Coordinate backfilling with utilities testing and inspections.

3.12 FILL

- A. Preparation: Remove vegetation, topsoil, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface before placing fills.
- B. Place and compact fill material in layers to required elevations as follows:
 - 1. Under grass and planted areas, use satisfactory top-soil material.
 - 2. Under walks and pavements, use satisfactory on-site soil material.
 - 3. Under building slabs, use imported select fill.
 - 4. Under footings and foundations, use imported select fill.

3.13 MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill layer before compaction to within 2 percent of optimum moisture content.
 - 1. 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.

3.14 COMPACTION OF BACKFILLS AND FILLS

- A. Compact soil to not less than the following percentages of maximum dry density according to ASTM D 698:
 - 1. Building Pad: Under structures, building slabs and footings of newly excavated subgrade, the soil surface shall be scarified to a minimum depth of six inches, moisture added as required to bring moisture content to within the allowed range of optimum, and recompacted to a minimum density as required. Select fill shall be placed in successive horizontal layers of not more than 10 inches in loose depth for the full width of the building cross-section. Compact each layer of backfill or fill material to 95 percent. See Soils Report for additional requirements.
 - a. Areas to receive select fill shall be cleared of all organic and other deleterious material.

- b. Each layer of select fill shall be uniform as to material, density and moisture content before beginning compaction. Where layers of unlike materials about each other, each layer shall be fed or the material shall be so mixed as to prevent abrupt changes in the soil.
 - c. Wetting or drying of the material and manipulation when necessary to secure a uniform moisture content throughout the layer shall be required. Should the material be too wet to permit proper compaction or rolling, work on all portions of the select fill thus affected shall be delayed until the material has dried to the required moisture content.
- 2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill material at 92 percent.
- 3. Under lawn or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill material at 85 percent.

3.15 GRADING

- A. General: Uniformly grade areas to a smooth surface, free from 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. Fill low spots, and trim high spots to comply with required surface tolerances.
- B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
 - 1. Lawn or Unpaved Areas: Plus or minus 1 inch.
 - 2. Walks: Plus or minus 1 inch.
 - 3. Pavements: Plus or minus 1/2 inch.
- C. Grading inside Building Lines: Finish subgrade to a tolerance of 1 inch when tested with a 10-foot straightedge.
- D. Landscape Areas: Fine grade landscape areas to a smooth, even surface with loose, uniformly fine texture. Roll, rake and drag lawn areas, remove ridges and fill depressions, as required to meet finish grades. Limit fine grading to areas which can be planted immediately after grading. Finish areas to receive topsoil to within not more than 0.10' above or below required subgrade elevations. Place and compact a minimum of 3" of satisfactory topsoil and fine grade.
 - 1. Finish grade of topsoil to be 1" below all tops of curbs and 1" below all tops of sidewalks.
 - 2. Place all topsoil to maintain a positive slope away from all buildings.
 - 3. Provide berms and contours as shown on landscape drawings.

3.16 SUBBASE COURSE

- A. Under pavements, place subbase course on prepared subgrade and as follows:
 - 1. Compact subbase 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 D 1557.
 - 2. Shape subbase to required crown elevations and cross-slope grades.
- B. Pavement Shoulders: Place shoulders along edges of subbase to prevent lateral movement. Construct shoulders, at least 12 inches wide, of satisfactory soil materials and compact with each subbase and base layer to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.

3.17 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.
- B. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison when approved by Engineer.

- C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, 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 5000 sq. ft. 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 each 150 feet 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 each 150 feet or less of trench length, but no fewer than two tests.
- D. 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 to depth required; recompact and retest until specified compaction is obtained.

3.18 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic 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. Scarify or remove and replace soil material to depth as directed by Engineer.
- 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 the greatest extent possible.

3.19 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove surplus soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

END OF SECTION

SECTION 31 31 20

SOIL TREATMENT

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes:
 - 1. Soil pretreatment to provide chemical barrier to termite infestation adjacent to and under building slabs.

1.02 SUBMITTALS

- A. Product Data: Treatments and application instructions, including EPA-Registered Label.
- B. Warranties: Special warranties specified in this Section.

1.03 QUALITY ASSURANCE

- A. Applicator Qualifications: An applicator who is licensed according to regulations of authorities having jurisdiction to apply termite control treatment in jurisdiction where Project is located and who is experienced and has completed termite control treatment similar to that indicated for this Project and whose work has a record of successful in-service performance.
- B. Regulatory Requirements: Formulate and apply termiticides, and label with a Federal registration number, to comply with EPA regulations and authorities having jurisdiction.

1.04 PROJECT CONDITIONS

- A. Environmental Limitations: To ensure penetration, do not treat soil that is water saturated. Do not treat soil while precipitation is occurring or anticipated. Comply with EPA-Registered Label requirements and requirements of authorities having jurisdiction.
- B. Coordinate soil treatment application with excavating, filling, and grading and concreting operations. Treat soil under footings, grade beams, and ground-supported slabs, before construction.

1.05 WARRANTY

- A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Special Warranty:
 - 1. Termite Warranty: Written warranty, signed by applicator and Contractor certifying that termite control work, consisting of applied soil termiticide treatment, will prevent infestation of subterranean termites. If subterranean termite activity or damage is discovered during warranty period, re-treat soil and repair or replace damage caused by termite infestation.
- C. Warranty Period:
 - 1. Termite Warranty Period: Five years from date of application.

2. Revegetation Warranty Period: One year from date of application.
- D. Continuing Service: Provide for continuing service, including monitoring, inspection, and retreatment for occurrences of termite activity, for the warranty period, starting on the date of Substantial Completion.

PART 2 - PRODUCTS

2.01 SOIL TREATMENT

- A. Termite Treatment: Provide an EPA-registered termiticide complying with requirements of Arizona Department of Agriculture, in a soluble or emulsible, concentrated formulation that dilutes with water or foaming agent, and formulated to prevent termite infestation. Use only soil treatment solutions that are not harmful to plants. Provide quantity required for application at the label volume and rate for the maximum termiticide concentration allowed for each specific use, according to the product's EPA-Registered Label.
 1. Approved Manufacturers:
 - a. Dragnet SFR (Permethrin); FMC Corporation.
 - b. Prelude (Permethrin); Amvac Chemical Corp.
 - c. Masterline 7.9 (Bifenthrin); Univar Environmental.
 - d. Talstar (Bifenthrin); FMC Corporation.
 - e. Premise 75 (Imidacloprid); Bayer Environmental.
 - f. Dominion 2L (Imidacloprid); Control Solutions, Inc.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas, and conditions, with Applicator present, for compliance with requirements for moisture content of the soil, interfaces with earthwork, slab and foundation work, landscaping, and other conditions affecting performance of termite control.

3.02 PREPARATION

- A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's written instructions for preparing substrate. Remove all extraneous sources of wood cellulose and other edible materials such as wood debris, tree stumps and roots, stakes, formwork, and construction waste wood from soil and around foundations.
- B. Soil Treatment Preparation: Remove foreign matter and impermeable soil materials that could decrease treatment effectiveness on areas to be treated. Termiticides may be applied before placing compacted fill under slabs if recommended by termiticide manufacturer.

3.03 APPLICATION, GENERAL

- A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's EPA-Registered Label for products.

3.04 TERMITICIDE APPLICATION

- A. Application: Mix soil treatment termiticide solution to a uniform consistency. Provide quantity required for application at the label volume and rate for the maximum specified concentration of termiticide,

according to manufacturer's EPA-Registered Label, to the following so that a continuous horizontal and vertical termiticidal barrier or treated zone is established around and under building construction. Distribute the treatment evenly.

1. Slabs-on-Grade: Ground-supported slab construction, including footings, building slabs, and attached slabs as an overall treatment. Treat soil materials before concrete footings and slabs are placed.
 2. Foundations: Adjacent soil including soil along inside of perimeter foundation walls, around plumbing pipes and electric conduit penetrating slab, and around interior column footings; and along entire outside perimeter, from grade to bottom of footing. Avoid soil washout around footings.
 3. Trenches: Top 24 inches of trench.
 4. Masonry: Treat voids.
 5. Penetrations: At expansion joints, control joints, and areas where slabs could be penetrated.
- B. Avoid disturbance of treated soil after application. Keep off treated areas until completely dry.
- C. Protect termiticide solution, dispersed in treated soils and fills, from being diluted until ground-supported slabs are installed. Use waterproof barrier according to EPA-Registered Label instructions.
- D. Reapply soil treatment solution to areas disturbed by subsequent excavation, grading, landscaping, or other construction activities following application.

3.05 FIELD QUALITY CONTROL

- A. Tests: Chemical analysis tests shall be made of materials used on the basis of one test for each 10,000 square feet of treated area. Samples and test may be taken of both concentrates and the dilute materials as being applied.

3.06 PROTECTION

- A. Adjacent property, trees and plants shall be protected from injury and damage as result of operations in this Section.

END OF SECTION

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SECTION 32 12 16

ASPHALT PAVEMENT

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes the following:
 - 1. On-site hot-mix asphalt paving.
 - 2. Hot-mix asphalt patching.
- B. Related Sections include the following:
 - 1. Section 32 20 00 for "Earthwork" for aggregate subbase and base courses and for aggregate pavement shoulders.
 - 2. Section 32 17 23 for "Traffic Marking Paint" for pavement markings.
 - 3. Section 32 13 13 for "Site Concrete Paving" for decorative concrete paving.
 - 4. Section 07 92 00 for "Joint Sealers" for joint sealants and fillers at paving terminations.

1.02 SYSTEM DESCRIPTION

- A. Provide hot-mix asphalt paving in compliance with materials, workmanship, and other applicable requirements of UDOT Standard Specifications.
 - 1. Mix-Design: R-19mm Marshall

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated, include technical data and tested physical and performance properties.
- B. Job-Mix Designs: Certification of approval of each job mix proposed for the Work.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver asphalt mixture to jobsite to maintain minimum temperature of 250 degrees.

1.05 PROJECT CONDITIONS

- A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp or if the following conditions are not met:
 - 1. Prime and Tack Coats: Minimum surface temperature of 60 deg F.
 - 2. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.
 - 3. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.
- B. Grade Control: Establish and maintain required sub-base lines and elevations to maintain uniform pavement thicknesses and grades.

PART 2 - PRODUCTS

2.01 AGGREGATES

- A. General: Use locally available materials and gradations that have performed satisfactorily in previous installations.
- B. Coarse Aggregate: ASTM D 692, sound; angular crushed stone or crushed gravel.
- C. Fine Aggregate: ASTM D 1073, sharp-edged natural sand or sand prepared from stone, gravel, properly cured blast-furnace slag, or combinations thereof.
- D. Mineral Filler: ASTM D 242, rock or slag dust, hydraulic cement, or other inert material.

2.02 ASPHALT MATERIALS

- A. Asphalt Binder: AASHTO MP 1, PG 64-22.
- B. Asphalt Cement: ASTM D 3381 for viscosity-graded material, PG 70-10.
- C. Water: Potable.

2.03 MIXES

- A. On-Site Hot-Mix Asphalt: Dense, hot-laid, hot-mix asphalt plant mixes in conformance with 2022 UDOT Standard Specifications.
 - 1. Approved Mix: 3/4" (R-19mm Marshall)
 - 2. Asphalt: minimum 5% by volume.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that subgrade is dry and in suitable condition to support paving and imposed loads.
- B. Proof-roll subbase using heavy, pneumatic-tired rollers to locate areas that are unstable or that require further compaction.
- C. Proceed with paving only after unsatisfactory conditions have been corrected.

3.02 PATCHING

- A. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting into new, hot-mix asphalt paving at a rate of 0.05 to 0.15 gal./sq. yd.
 - 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
 - 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.
- B. Patching: Fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact flush with adjacent surface.

3.03 SURFACE PREPARATION

- A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.

3.04 HOT-MIX ASPHALT PLACING

- A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.
 - 1. Place hot-mix asphalt base course in thicknesses indicated.
 - 2. Place hot-mix asphalt surface course in single lift.
 - 3. Spread mix at minimum temperature of 250 deg F.
- B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.
- C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.05 JOINTS

- A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions with same texture and smoothness as other sections of hot-mix asphalt course.
 - 1. Clean contact surfaces and apply tack coat to joints.
 - 2. Compact joints as soon as asphalt will bear roller weight without excessive displacement.

3.06 COMPACTION

- A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement.
 - 1. Complete compaction before mix temperature cools to 185 deg F.
- B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.
- C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:
 - 1. Average Density: 96 percent of reference laboratory density according to AASHTO T 245, but not less than 94 percent nor greater than 100 percent.
- D. Finish Rolling: Finish rolled surfaces to remove roller marks while hot-mix asphalt is still warm.
- E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.
- F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh asphalt. Compact by rolling to specified density and surface smoothness.

3.07 INSTALLATION TOLERANCES

- A. Thickness: Compact each course to thickness indicated within the following tolerances:
 - 1. Base Course: Plus or minus 1/4 inch.
 - 2. Surface Course: Plus 1/4 inch, no minus.
- B. Surface Smoothness: Compact each course to produce a surface smoothness within 1/4 inch in a 10-foot straightedge applied transversely or longitudinally to paved areas.

3.08 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and to prepare test reports to confirm thicknesses and densities.
- B. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- C. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.
- D. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.
- E. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

END OF SECTION

SECTION 32 13 13

SITE CONCRETE PAVING

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes exterior concrete pavements for the following:
 - 1. Driveways and roadways.
 - 2. Curbs and gutters.
 - 3. Light-broom finish sidewalks and walkways.
 - 4. Truck-dock aprons.
 - 5. Exit access stairs.
- B. Related Sections include the following:
 - 1. Section 31 20 00 for "Earthwork" for sub-grade preparation, grading, and sub-base course.
 - 2. Section 03 30 00 for "Cast-in-Place Concrete" for general building applications of concrete.

1.02 RELATED DOCUMENTS

- A. Refer to soil and pavement recommendations of the Project Soils Report listed in Document 00880 "Soils Investigation Data".

1.03 SUBMITTALS

- A. Product Data: For each type of manufactured material and product indicated.
- B. Design Mixes: For each concrete pavement mix. Include alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed pavement work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.
- C. Regulatory Requirements: Comply with local code and regulatory requirements for accessible design and the following:
 - 1. 2010 – "ADA Standards for Accessible Design".
- D. Mockups: Before installing special finish pavements, build mockups to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mockups using materials indicated for the completed Work:
 - 1. Build mockups for in sizes approximately 48 inches long by 96 inches long.
 - 2. Approval of mockups is for color, texture, and blending of special finish pavements. Maintain mockups during construction in an undisturbed condition as a standard for comparing the completed Work. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.05 PROJECT CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required in the public right-of-way or for other construction activities.

PART 2 - PRODUCTS

2.01 FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces.
- 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.

2.02 STEEL REINFORCEMENT

- A. Plain-Steel Welded Wire Fabric: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.
- B. Reinforcement Bars: ASTM A 615, Grade 60, deformed.
- C. Steel Bar Mats: ASTM A 184/A 184M; with ASTM A 615, Grade 60, deformed bars; assembled with clips.
- D. Tie Bars: ASTM A 615/A 615M, Grade 60, deformed.
- E. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcement bars, welded wire fabric, and dowels in place.

2.03 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type II, alkali content not to exceed 0.6 percent.
- B. Fly Ash: ASTM C 618, Class F, proportioned in accordance with ACI 232-4.1. Combined fly ash, silica fume or other pozzolans shall not exceed the following percentages of cement by weight:
 - 1. Slabs-on-Grade: 15 percent.
 - 2. Integral-Color Slabs-on-Grade: Not allowed.
 - 3. Drives, Curbs and Gutters: 25 percent.
- C. Aggregate: ASTM C 33, uniformly graded, not less than Class 1N coarse aggregate, free of substances with deleterious reactivity to alkali in cement.
 - 1. Nominal Maximum Course Aggregate Size: 1 1/2 inches.
 - 2. Fine Aggregate: Clean, washed, sand and gravel, from same source as course aggregate.
- D. Water: ASTM C 94, potable.

2.04 ADMIXTURES

- A. General: Admixtures certified by manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cement and to be compatible with other admixtures.
- B. Air-Entraining Admixture: ASTM C 260, compatible with other admixtures.

2.05 CURING MATERIALS

- A. Exterior Curing and Sealer: Clear, self-dissipating, waterborne, membrane-forming curing and sealing compound ASTM C 1315, Type 1, Class B. Acceptable products include:
 - 1. Vocomp 30; W. R. Meadows, Inc.
 - 2. Dress & Seal 30; L&M Construction Chemicals, Inc.
 - 3. Kure-N-Seal 30; BASF Construction Chemicals.

2.06 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.
- 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 and grade to suit requirements.
- D. Expansion Joint Filler Strips: At slabs abutting vertical elements or other cold-joints, ASTM D 1751, cellulosic-foam; 1/2-inch thick with removable cap-strip cover for subsequent application of sealant. Acceptable Products include:
 - 1. Snap-Cap; W. R. Meadows, Inc.
 - 2. Normaflex; Nomaco.
- E. Pavement Markings: As specified in Section 32 17 23 "Traffic Marking Paint".

2.07 CONCRETE MIXES

- A. Prepare design mixes, proportioned according to ASTM C 94 and ASTM C 1116, for each type and strength of concrete determined by laboratory trial mixes. Proportion mixes with the following properties:
- B. Walkways, Sidewalks and Stairs: Proportion normal-weight concrete mix as follows:
 - 1. Compressive Strength (28 Days): 3000 psi.
 - 2. Maximum Slump: 4 inches.
 - 3. Maximum Water-Cementitious Materials Ratio: 0.55.
 - 4. Air-Entrainment: 4 percent, plus or minus 1 1/2 percent.
- C. C.I.P. Curbs and Gutters: Proportion normal-weight concrete mix as follows:
 - 1. Compressive Strength (28 Days): 3000 psi.
 - 2. Maximum Slump: 4 inches.
 - 3. Maximum Water-Cementitious Materials Ratio: 0.48.
- D. Driveways and Truck-Courts: Proportion normal-weight concrete mix as follows:
 - 1. Compressive Strength (28 Days): 3500 psi.
 - 2. Maximum Slump: 4 inches.
 - 3. Maximum Water-Cementitious Materials Ratio: 0.50.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Compact subbase surfaces to eliminate unstable areas. Proceed with pavement only after nonconforming conditions have been corrected and subgrade is ready to receive pavement.
 - 1. 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.

3.03 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating reinforcement and with recommendations in CRSI's "Placing Reinforcing Bars" for reinforcement.
- B. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
- C. Install welded wire fabric 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.
- D. 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 6-inch overlap to adjacent mats.

3.04 JOINTS

- A. General: Construct 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.
- B. Construction Joints: Set construction joints at side and end terminations of pavement, unless pavement terminates at isolation joints.
- C. Isolation Control 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 sidewalk expansion joints at intervals of 20 feet unless otherwise indicated.
 - 2. Locate curb and gutter expansion joints at intervals of 20 feet unless otherwise indicated.
 - 3. Extend joint fillers full width and depth of joint, but not less than 1/2 inch or more than 1 inch below finished surface for joint sealant application.
- D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows:
 - 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 grooving tool marks on concrete surfaces.
- E. Sawed Joints: Form contraction joints with power saws equipped with 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. Cut joints 1/3 of overall slab depth.
- F. Edging: Tool edges of gutters, curbs, and joints in concrete after initial floating with an edging tool to the following radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces. Provide 3/8 inch radius edges.
- G. Sealants: At isolation and expansion joints provide sealant per Section 07 92 00 "Sealants". Dust traffic joints with mica sand before sealant has formed a skin.

3.05 CONCRETE PLACEMENT

- A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcement steel, and items to be embedded or cast in. Notify other trades to permit installation of their work.

- B. 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.
- C. Moisten subbase to provide a uniform dampened condition at the time concrete is placed. Do not place concrete around manholes or other structures until they are at the required finish elevation and alignment.
- D. Consolidate concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping.
- E. Screed pavement surfaces with a straightedge and strike off. Commence initial floating using bull floats or darbies to form 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 dry-shake surface treatments.
- F. Exterior Stairs: Construct stairs to conform to sizes and arrangements indicated; form exterior treads and landings to maintain drainage.
 - 1. Form exterior treads and landings to maintain drainage.
 - 2. Non-slip Broom Finish: Apply a medium-broom finish to exterior treads, stoops and platforms.
 - 3. Nosings: 3-inch wide one-piece extruded aluminum body with non-slip epoxy filled abrasive strips. Approved products include:
 - a. R-315-PC; Balco, Inc.
 - b. STSB-P3E; Nystrom Building Products.
 - c. BSTSB-P3E; Babcock-Davis.

3.06 CONCRETE FINISHING

- A. General: Wetting of concrete surfaces during screeding, initial floating, or finishing operations is prohibited.
- B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and the 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.
 - 2. Truck-Dock Aprons: Produce a uniform, heavy-to-medium, textured broom finish by drawing a soft bristle broom across float-finished concrete surface, perpendicular to dock doors.

3.07 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive hot temperatures. Comply with ACI 305R for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause excessive moisture loss during finishing operations.
- C. Begin curing after finishing concrete, but not before free water has disappeared from concrete surface.
- D. 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.

3.08 PAVEMENT TOLERANCES

- A. Comply with tolerances of ACI 117 and as follows:

1. Elevation: 1/4 inch.
 2. Thickness: Plus or minus 1/4 inch.
 3. Surface: Gap below 10-foot long, unleveled straightedge not to exceed 1/4 inch.
 4. Joint Spacing: 3 inches, plus or minus.
- B. At accessible ramps and sidewalk routes, comply with regulatory requirements for accessible design tolerances and as follows:
1. Elevation: Plus or minus 1/8 inch.
 2. Surface: Gap below 10-foot long straightedge not to exceed 1/8 inch.
 3. Ramp Slopes and Cross-Slopes: plus or minus 1/16 inch in 12 inches, not exceeding 1/8 inch in 5 feet.

3.09 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing and inspection agency to sample materials, perform tests, and submit test reports during concrete placement.
- B. Testing Services: Testing shall be performed according to the following requirements:
1. Air Content: ASTM C 231, pressure method; one test for each compressive-strength test, but not less than one test for each day's pour of each type of air-entrained concrete.
 2. Compressive-Strength Tests: ASTM C 39; one set for each day's pour of each concrete class exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. One specimen shall be tested at 7 days and two specimens at 28 days; one specimen shall be retained in reserve for later testing if required.
- C. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 24 hours of testing. Reports of compressive-strength tests shall contain design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

3.10 REPAIRS AND PROTECTION

- A. Remove and replace concrete pavement that is broken, damaged, or defective, or does not meet requirements in this Section.
- B. 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.
- C. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep and power wash concrete pavement not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION

SECTION 32 17 23

TRAFFIC MARKING PAINT

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes the following traffic markings at locations as shown on Drawings.
 - 1. Fire-lane curbs.
 - 2. Car parking stall striping.
 - 3. ADA accessibility designations.
- B. Related Sections include the following:
 - 1. Section 32 12 16 – “Asphalt Paving” for pavement mix-designs.

1.02 SUBMITTALS

- A. Product Data: Submit manufacturer's product specification and installation instructions for marking paint.

1.03 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with local code and regulatory requirements for accessible design and the following:
 - 1. 2010 – “ADA Standards for Accessible Design”.
 - 2. City of Salt Lake Regulations.

1.04 PROJECT CONDITIONS

- A. Do not apply marking paint when weather is foggy or rainy, or ambient or pavement temperatures are below 40 degrees F., or when such conditions are anticipated during twenty-four hours after application.

1.05 COORDINATION

- A. Coordinate paint applications with final cleaning of exterior pavements.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, with pigment solids by weight of not less than 55%, complying with FS TT-P-1952, Type II, with drying time of less than 15 minutes.
- B. Approved Manufacturers:
 - 1. Zoneline 11-3 Series; PPG Architectural Coatings.
 - 2. Techline; US Specialty Coatings.
 - 3. Fast Dry EF Series; Ennis-Flint.
 - 4. Pro-Park; Sherwin-Williams.

- C. Paint Colors:
- | | |
|-------------------------------|--------|
| 1. Fire Lanes | Red |
| 2. Parking Spaces | White |
| 3. Handicapped Parking Symbol | White |
| 4. Handicapped Aisle Striping | Yellow |

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify pavements have been accepted and approved prior to beginning paint applications or layouts.

3.02 PREPARATION

- A. Preparation: Locate markings as shown on Drawings and required by Fire Dept. Provide qualified technician to supervise equipment and application of markings. Lay out markings using guide lines, templates, and forms.
- B. Thoroughly clean surfaces free of dirt, sand, gravel, oil and other foreign materials.

3.03 APPLICATION

- A. General: Apply marking paint at rate of one gallon per 100 sq. ft. or approximately 300 lineal feet of 4 in. wide stripe.
- B. Apply marking paint straight and uniform.
- C. Keep off painted areas until completely dry.

END OF SECTION

SECTION 32 31 19

ORNAMENTAL METAL FENCING AND GATES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Sliding gates and related hardware.
 - 2. Gate operators.
 - 3. Tubular steel picket fencing.

1.02 SUBMITTALS

- A. Product Data: Material descriptions, construction details, dimensions of individual components and profiles, and finishes for the following:
 - 1. Fence and gate posts, rails, and fittings.
 - 2. Gates and hardware.
 - 3. Gate operators, including operating instructions.
 - 4. Motors: Show nameplate data, ratings, characteristics, and mounting arrangements.
- B. Shop Drawings: Show locations of fence, each gate, posts, rails, and tension wires and details of extended posts, extension arms, gate operation, hardware, and accessories. Indicate materials, dimensions, sizes and finishes of components. Include plans, elevations, sections, gate swing and other required installation and operational clearances, and details of post anchorage and attachment and bracing.
 - 1. Gate Operator: Show locations and details for installing operator components, switches, and controls. Indicate motor size, electrical characteristics, mounting, and grounding provisions.
 - 2. Wiring Diagrams: Indicate manufacturer-installed and field-installed wiring power and control wiring provided by gate operator manufacturer and those provided by others.
- C. Product Certificates: Signed by manufacturers of fences and gates certifying that products furnished comply with requirements.
- D. Maintenance Data: Include in maintenance manuals for gate operator.

1.03 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Field Measurements: Verify actual locations of structural supports for fence and gate panels by field measurements before fabrication and indicate measurements on Shop Drawings.
- D. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating fence and gate panels without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.01 STEEL

- A. Plates, Shapes, and Bars: ASTM A 36.
- B. Tubing: ASTM A 500, cold formed steel tubing.
- C. Bars: Hot-rolled steel strip, ASTM A 1011, Commercial Steel, Type B.

2.02 COATING MATERIALS

- A. Shop Primers for Steel: Provide primers that comply with Section 09 91 13 "Exterior Painting."

2.03 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Concrete: Normal-weight, air-entrained, ready-mix concrete complying with requirements in Section for "Cast-in-Place Concrete" with a minimum 28-day compressive strength of 3000 psi, 3-inch slump, and 1-inch maximum aggregate size.
- C. Nonshrink Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107 and specifically recommended by manufacturer for exterior applications.

2.04 FENCE PANELS

- A. Square Steel Tubing: ASTM A 513, hot-rolled G-90 galvanized steel tubing. Fabricate members from square tubing formed from 0.108-inch nominal-thickness, mill finish.
 - 1. Pickets: Minimum 1" x 1" x 16 ga. square tubing at 6-inches o.c.
 - 2. Rails: Minimum 2" x 2" x 14 ga. square tubing.
 - 3. Post: Minimum 3" x 3" x 11 ga. square tubing.
 - 4. Swing Gate Posts, (3-ft. to 6-ft. wide leaf): Minimum 4" x 4" x 11 ga. square tubing.
 - 5. Swing Gate Posts, (6-ft. to 12-ft. wide leaf): Minimum 1/4" x 8" x 8" square tubing.
 - 6. Slide Gate Post: Minimum 1/4" x 8" x 8" x square tubing.
- B. Frame Construction: MIG welded, flush-ground.
- C. Steel Finish: Phosphatized non-chromate primer with manufacturers standard baked enamel coating finish.
 - 1. Color: Black.

2.05 VEHICULAR HORIZONTAL SLIDE GATES

- A. General: Comply with ASTM F 1184 for the following slide-gate types:
 - 1. Double bi-parting gate.
- B. Frames and Bracing: Fabricate members from steel tubing as follows:
 - 1. Leaf Width and Height: As indicated on Drawings.
 - 2. Intermediate Frame Members: 2" x 2" x 14 ga. square tubing.
 - 3. Perimeter Frame Members: 3" x 3" x 11 ga. square tubing.
- C. Gate Panels: 1" x 1" x 16 ga. square tubing at 6-inches o.c.
- D. Overhead Track Assembly: Manufacturer's standard heavy duty track, with overhead framing supports, ball-bearing hanger sheaves, guide stays, bracing, and accessories, engineered to support size, weight, width, operation, and design of gate and roller assemblies.

- E. Hardware: Latches permitting operation from both sides of gate, locking devices hangers roller assemblies and stops fabricated from galvanized steel. Fabricate latches with integral eye openings for padlocking; padlock accessible from both sides of gate.
- F. Finish exposed welds to comply with NOMMA Guideline 1, Finish #2 - completely sanded joint, some undercutting and pinholes okay.

2.06 GATE OPERATORS

- A. General: Provide factory-assembled automatic gate operation system designed for gate size, type, weight, construction, use, traffic-flow patterns, and operation frequency. Provide operation system of size and capacity and with features, and accessories suitable for safe operation and duty-cycles as recommended by gate manufacturer complete with electric motor and factory-prewired motor controls, remote-control stations, control devices, power disconnect switch, obstruction detection device, lockable weatherproof enclosures protecting controls and all operating parts, and accessories required for proper operation.
 - 1. Provide enclosures with corrosion-resistant-protective and decorative finish.
 - 2. Provide unit designed and wired for both right-hand/left-hand opening, permitting universal installation.
 - 3. Coordinate operator wiring requirements and electrical characteristics with building electrical system. Include wiring from motor controls to motor.
- B. 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:
 - 1. Slide Gates: (AC voltage)
 - a. All-O-Matic: SL-150 AC. (1hp-2500 lbs)
 - b. Liftmaster: SL3000UL (1hp-2000 lbs)
 - c. Viking: H-10. (1hp-2200 lbs)
- C. Control Equipment: Comply with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70, Class 2 control circuit, maximum 24V ac or dc.
- D. Electromechanical Operation: Provide unit designed for gate and concrete base/pad; consisting of electric motor and factory-prewired motor controls, starter, speed control device, chain-drive assembly, clutch or torque limiter, and as follows:
 - 1. V-belt and worm gear chain and sprocket reducers, roller chain drive.
 - 2. Enclosed worm gear reducer, wheel and rail drive.
- E. Operation Cycle Requirements: Design gate operator to operate for not less than the following duty and cycles per hour. One cycle equals one gate opening plus one gate closing.
 - 1. Heavy Duty: 25 cycles per hour.
 - 2. Sliding Gate Operation Speed: Minimum 60 fpm.
- F. Electric Motors: Reversible, continuous-duty, insulated electric motors, complying with UL325, sized to start and operate gate leaf of lengths indicated.
 - 1. Sliding Gate Leaf Weight: 1800 lbs.
- G. Remote Controls: Electric controls separated from gate and motor and drive mechanism, with NEMA ICS 6, Type 1 enclosure for surface concrete base/pad mounting, and with space for additional optional equipment. Provide the following remote-control device(s):
 - 1. Control Station: Momentary-contact, single-button-operated control station with open and close functions.
 - 2. Digital Keypad Entry Unit: Functions only when authorized code is entered. Multiple-code capability.
- H. Vehicle Loop Detector System: System including automatic closing timer with adjustable time delay timer cut-off switch and loop detector designed to open and close gate, hold gate open until traffic clears and reverse gate. Provide electronic detector, with adjustable detection patterns, adjustable sensitivity and frequency settings, and panel indicator light designed to detect presence or transit of a

vehicle over an embedded loop of wire and to emit a signal activating the gate operator. Provide multi-strand wire for pave-over installation.

- I. Obstruction Detection Devices: Provide each motorized sliding gate with automatic safety sensor(s). Activation of sensor(s) causes operator to immediately function as follows:
 - 1. Action: Stop gate in opening cycle and reverse gate in closing cycle and hold until clear of obstruction.
 - 2. Photoelectric/Infrared Sensor System: Designed to detect an obstruction in partition's path by interruption of an infrared beam in the zone pattern without obstruction contacting gate.
- J. Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop gate at fully retracted and fully extended positions.
- K. Operating Features: Include the following:
 - 1. Master/Slave Capability: Control stations designed and wired for double gate pair operation.
 - 2. Automatic Closing Timer: With adjustable time delay before closing.
- L. Accessories: Include the following:
 - 1. Call-Box Mounting kit including pedestal.
 - 2. Battery Backup System: Battery-powered drive and access control system, independent of primary drive system, opening gate if power fails.
 - 3. Pre-Emption Detectors: Tomar 1790.
 - 4. Fire Dept. Knox box: Knox Model 3502 keyswitch.

2.07 CAST-IN-PLACE CONCRETE

- A. Materials: Portland cement complying with ASTM C 150, Type I aggregates complying with ASTM C 33, and potable water for ready-mixed concrete complying with ASTM C 94.
 - 1. Concrete Mixes: Normal-weight concrete with not less than 3000-psi compressive strength.
- B. Materials: Dry-packaged concrete mix complying with ASTM C 387 for normal-weight concrete mixed with potable water according to manufacturer's written instructions. Dry-packaged concrete mix may be used meeting minimum strength requirements as noted.
- C. Concrete Bases/Pads: Cast-in-place or precast concrete, made of not less than 3000-psi compressive strength (28 days), depth not less than 12 inches, dimensioned and reinforced according to gate operator component manufacturer's written instructions.
- D. Post Footings: Footings shall be 3,000 psi after twenty-eight (28) days concrete. Diameter and depth of footings shall be as follows, unless otherwise indicated on the Drawings.
 - 1. 3-inch square post: Min. 12" dia., 36" in depth.
 - 2. 4-inch square post: Min. 12" dia., 36" in depth.
 - 3. 6-inch square post: Min. 18" dia., 48" in depth.

2.08 STEEL FINISHES

- A. Painted Finish: Clean surfaces according to SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 1. Primer Application: Apply zinc-rich epoxy primer immediately after cleaning, to provide a minimum dry film thickness of 2 mils per applied coat, to surfaces that will be exposed after assembly and installation, and to concealed surfaces.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, construction layout, and other conditions affecting performance of the Work.
- B. Do not begin installation before final grading is completed unless otherwise permitted by Architect.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Stake locations of fence lines and terminal posts. Verify opening dimensions between pier and wall elements. Verify locations of underground utilities, lawn sprinkler systems, underground piping to avoid conflicts with post placement.

3.03 GATE INSTALLATION

- A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage.

3.04 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.

END OF SECTION

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